HEATING AND VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH THE DESIGN AND APPLICATION OF AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION IN BUILDINGS

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THIS MONTH'S COVER

An Accelerator installed at Decatur, Ill., for clarifying and treating water. Treatment is necessary to provide a water of definite characteristics and quality. Photograph, courtesy of Infilco, Inc., Chicago.

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Washington News

LORING F. OVERMAN

BY the time HEATING AND VENTILATING rolls off the presses next month, Washington will have the answer to a very engrossing topic—who will quarterback the Federal team. To a lot of folks in Washington, the answer to this question is a bread-and-butter topic. But to the country as a whole, changing the quarterback, or keeping the old one, won't make so great a difference.

Reason is that the game will be the same regardless of the color of the players' uniforms. The rules will permit the quarterback, whoever he may be, to call only certain plays. True, the present team, many contend, has found it convenient to change the rules a bit as the game progressed. But chances are that the spectators, after having been introduced to razzle-dazzle politics, wouldn't be content to settle back to line-bucking and flying wedges alone.

So the Washington game, as now constituted, will be pretty much the same after the elections. There'll be a big squad that won't reduce easily; one requiring a comparably large entourage of water boys, coaches, rubbers, press agents, and so on. There'll be an international schedule of games to play, instead of the old isolationist circuit. There'll be year 'round practice sessions, to keep the squad in shape to meet such doughty players as Kremlin university.

Consequently, there'll be big overhead; little chance of trimming the team budget, and continued high taxes, high employment, high demand for scarce commodities, and continued high prices—at least for anything needed for the good of the team.

Stockpiling

As September ended, the Stockpiling genie was beginning to cast an expanding shadow over a scarce-commodities market already burdened by domestic requirements and demands from overseas. As the story is told in Washington, this country took an important part in winning a couple of wars rather recently. As of VE-day and VJ-day, the cork was put back in the bottle and the voracious appetite of the Stockpiling genie was considered terminated. No, it wasn't intended that the genie be entirely forgotten, for he had done the country a good turn in wartime. Instead, the plan was to loosen the cork now and then give the genie a small portion of tin, cork, lead, copper, zinc, and some 55 other commodities.

At first the plan was to feed the genie only when the delicacies he required were not needed by industry for domestic use. But from that day to this, industry has gobbled up everything it could lay hands on, and the poor genie has become woefully emaciated. Some months ago, Congress took a look at the bottle, and decided that something should be done about the genie's health, but it was estimated that he could probably be spoon fed for maybe five years. More recently, however, Washington has reluctantly decided that perhaps the genie had better be gotten into shape, just in case.

80% Underweight

When Congress became concerned about stockpiling last Spring, the Munitions Board proposed two plans for the genie's care—a minimum plan to cost about $3.4 billion dollars, and a maximum plan calling for an expenditure of some $12 billion. Congress figured the minimum plan would be ample, particularly since no new war was anticipated, and feeding on that basis has been under way for some time. To date, it is reported, only about 20% of the projected purchases have been completed, and that the stockpile is badly out of balance. For awhile the bins for half of the needed 60 critical items were entirely bare, but now there is reportedly something in all bins; quite a lot in others.

Of the 20% accumulated, the bulk came from Government surplus property. Contracts have been signed for about 7% more. By the end of June, 1949, if the Munitions Board uses all of its contracting authority, about 40% will be in sight. Although the original plan was to complete the pile in five years, Munitions Board spokesmen believe it will take at least seven years to complete even the minimum program contemplated.

If changing conditions abroad should dictate a speedup of the stockpiling program, industry may again have to turn to some of the substitutes that proved themselves workable and practicable in wartime. In such a possibility, there's food for thought for those who plan and schedule the production of heating, ventilating and air conditioning industries. But in the possibility, there may also lie new opportunities for the industry. For in the explorations that usually accompany a search for new or improved sources of supply, there are frequently developed entirely new applications in the refrigeration and air treatment fields.

Currently, the Munitions Board is pondering the fact that this country contains traces of many of the critical metals and materals which it now obtains abroad. While it would not "pay" to explore such nebulous resources, there are those in Washington who are urging that such a proposal be studied. Such a program, they contend, might be safer in the long run than to continue depending upon the far corners of the earth for our critical supplies.

In the meantime, expect stockpiling to become a more active bidder for the metals—basic and otherwise—in the months to come.

Stork vs. Housing Cost

By every standard of logic, housing has priced itself out of the market, and the construction industry is due for a slump. Strangely enough, sufficient housing is bought for reasons other than logic to

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keep the ball rolling, and the prospect's not a bit discouraging, at least for a year or more. This forceful substitute for logic is the peal of the marriage bell, the fluttering of the wings of the stork, and the incessant urge of Americans to migrate.

Just as the movies' Mr. Blandings built his home "with his heart, not his head," millions of others are demanding housing despite present prices—because they must have places to live. Of significance to heating, ventilating and air conditioning industries, however, is the fact that the bulk of housing demand is from those who "must" have quarters. Those whose projects are dictated by logic alone—the speculative builders, insurance company project-planners and others who are the real buyers of heating and ventilating equipment—are backing off for a second look. Where convinced that costs are too high to permit sales at a profit, or rents that will pay off, many such builders are calling a halt. Meanwhile, the "must have's" are reluctantly but unhesitatingly snapping up $6,000 houses at $10,000 or so.

The hoverings of the stork need not go unrejoiced even among those whose major interest is in large building design. Pent up is a demand for hospitals and schools, schools, schools. Communities all over the country, although rueing today's prices, are finding themselves forced to double bond issues and announce plans to go ahead. 1949 will be the first of many busy years in the school construction field.

In other "logic" fields—factories, office buildings, commercial buildings, theaters — planners are about convinced that the opportunities to profit from needed construction will outweigh the handicap of high prices. Forecast for construction in the commercial field is particularly high for the next two years.

Defense Buying

In addition to stockpile acquisitions, the Armed Forces are continuing to step up buying schedules. Army, Navy and Air Force are setting up uniform procurement rules, with field offices doing most of the purchasing. Lists of field offices and type of equipment they buy may be secured by writing the following: for Army, Current Procurement Branch, General Staff, Washington 25, D. C.; for Navy, Bureau of Supplies and Accounts, Washington 25, D. C., and for Air Force, Procurement Divisions, Air Materiel Command, Dayton, Ohio.

The stepped-up armament program and European Recovery Program may soon require a shifting around of workers, according to the National Security Resources Board. Twenty-two of 138 principal labor market areas have slight surpluses, according to the Bureau of Employment Security. Some shifting of labor will be necessary to fill gaps in shipbuilding and aircraft programs, it was indicated.

"Both the civilian economy and the defense program are reporting a shortage of professional men, including engineers of all types," commented Robert C. Goodwin, director of the Employment Security Bureau. Reflecting the need, previously referred to, for schools, he added, "The greatest absolute shortage among the professions is among teachers, especially in the primary and secondary grades."

Carloadings Down

Further evidence that a tightening of the belt may be in order is the fact that carloadings since January 1 are around 1,000,000 behind the comparable period in 1947, according to the Railway Car Institute. The Institute observes, however, that this figure may be a bit misleading, since the average weight of car loadings was stepped up. This was made possible, it was reported, by use of more powerful locomotives to move longer trains at higher speeds.

Although there have been fewer complaints of car shortages this year, the current peak Fall loadings of crops, fuel and equipment finds the railroads still contending with a dwindling supply of available cars. Despite the output of new cars at the rate of 10,000 monthly, a net decline of 66,853 freight cars is reported from VJ-day (1945) to August 1, 1948. Although the number of new cars turned out exceeds the number retired from service as worn out, there has been a sharp upturn in the number of cars idle and awaiting repair.

Labor Less Vocal

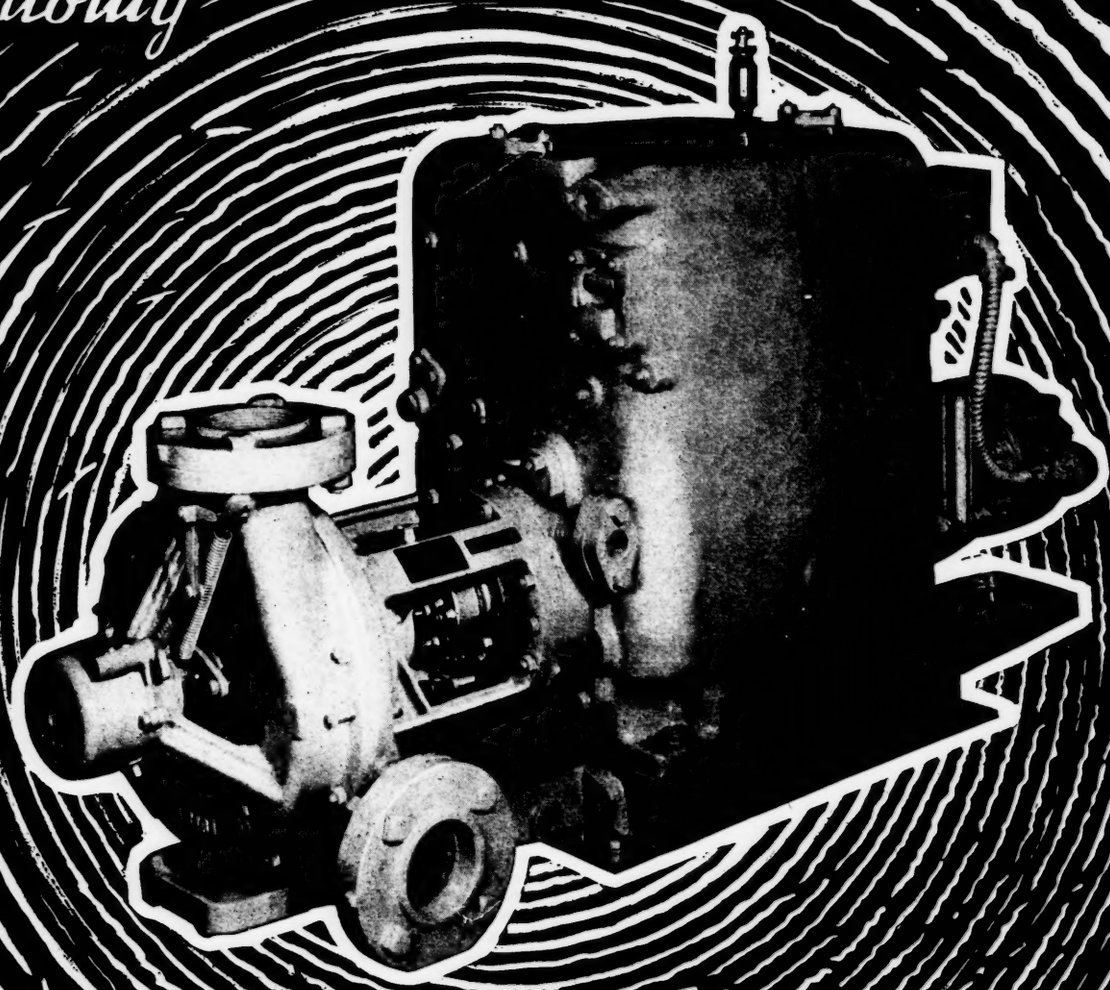
There are indications that the new Taft-Hartley labor law is shifting the balance somewhat in union-management relations, with management getting more of a break. Although high employment and generally favorable business conditions are normally taken as healthy strike conditions, few labor leaders seem inclined to go all the way. Instead a tendency to compromise is noted. There are some exceptions, but employers who decide to stand pat and take advantage of all provisions of the Taft-Hartley Act have often found it to their advantage to do so.

Left-wing unions find the non-communist affidavits a double deterrent. Refusal to sign subjects leaders to pressure from right wing members and raids by rival unions. In case of a strike, non-compliance with the affidavit requirement can lead to decertification of the union as the bargaining agent. In such cases, many lefty unions are finding strikes not worth the risk.

Among the more stable unions, there is no clear indication that there will be fourth round wage demands. Instead, there is a tendency to wait and see whether present leveling in durable goods prices, and sagging in soft wares, is the real thing or merely a pre-election hesitancy. One thing that management has often noted in dealing with well grounded unions is that leaders of such unions come to the conference table well backed with facts and figures compiled by efficient statisticians. Frequently the union is so much better prepared for the conference than is management that impartial arbiters had no choice other than to accept the union evidence.

Currently, these thoughtful union leaders are pondering the 1949 approach. While they may not mind worrying the goose a bit, they still respect her laying ability. With the lefties it's another story, but with the non-communist affidavit helpful in pointing out who's who, the possibility of a reasonable amount of labor peace in months ahead is brighter.

Centralized Heating Economy



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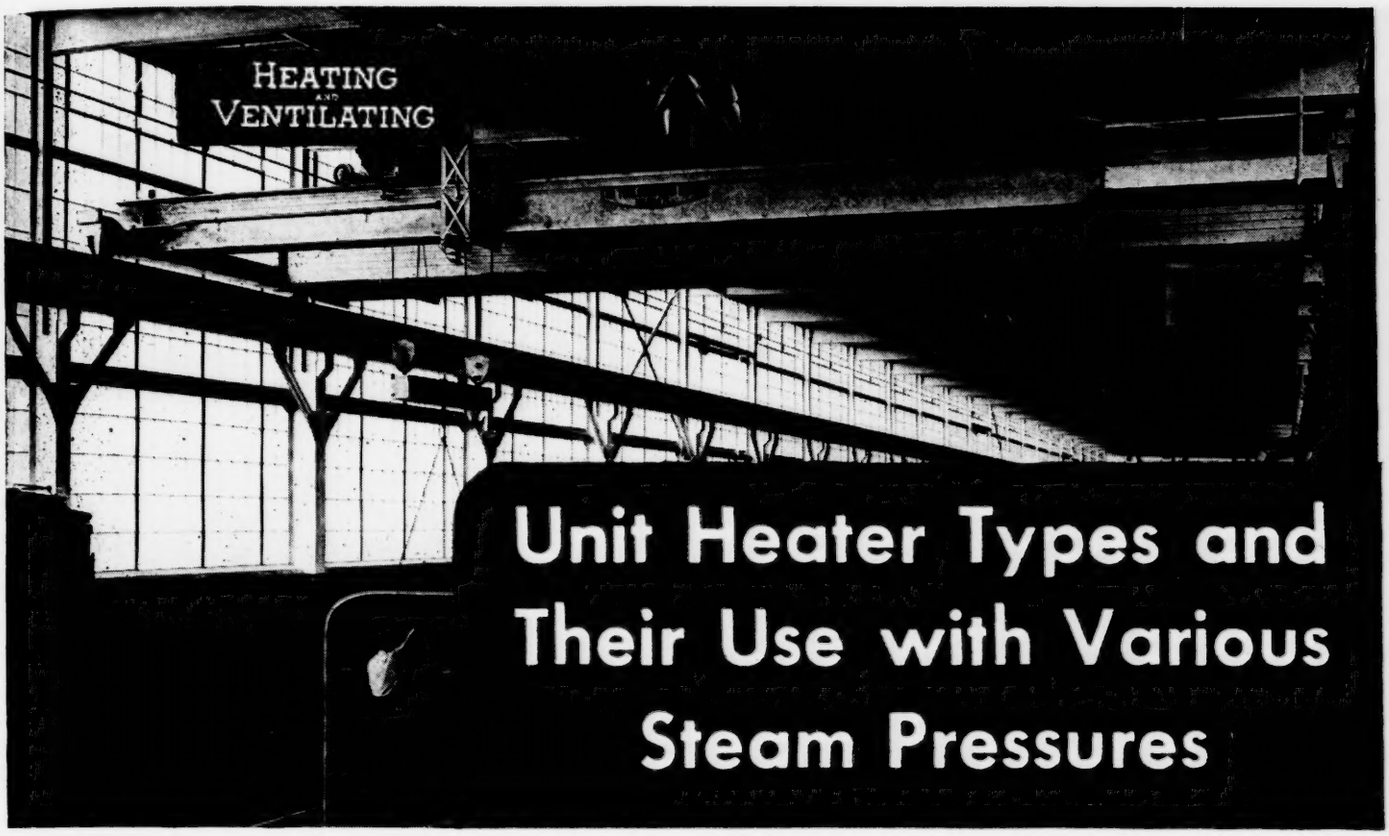


Unit Heater Types and Their Use with Various Steam Pressures

A projection type unit heater has been used in this relatively high location

G. S. WHITTAKER
Associate, Albert Kahn Associated Architects and Engineers, Inc.

Published discussion of unit heaters indicates that in heating system design procedure there is a considerable area where the opinion of the design engineer may have wide latitude in the selection of unit heater types. The staff of Albert Kahn Associated Architects and Engineers has designed a great many heating systems in large commercial and industrial buildings where unit heaters have been specified. Out of this experience, Mr. Whittaker offers this article including its opinions as a friendly contribution to the general discussion. He and the editors will welcome other informed opinions and discussion on the subject of unit heaters

UNIT heaters are divided, in general, into three types; first, the propeller type; second, the vertical or down blow type; and third, the blower type. Each of these types has a distinct advantage over the others in certain applications, in the writer's opinion, and cannot do itself justice in jobs for which it is not fitted.

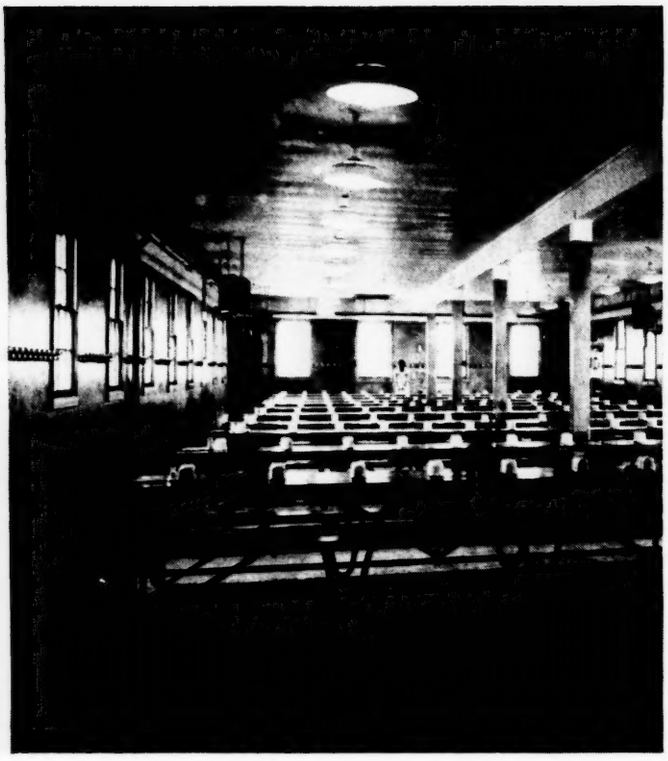
Propeller Type

The propeller type of unit heater is manufactured in sizes from 10,000 to 300,000 Btu per hr as base rating. This type of heater was probably the first one to be manufactured, particularly in large quantities. It is somewhat less costly than other types of a comparable size. As a rule, the propeller type of heater has a rather low velocity and covers a comparatively small area for its size which means more heaters are necessary to heat a given large area. Also, when used in this way, they depend more or less upon each other to circulate the air around the building.

This type of heater, our staff believes, is particularly adapted to places such as locker rooms, overhead toilets, garages, stores and other small areas with a reasonably low headroom. They suit this purpose very well and do an excellent job with a low first cost.

Down Blow Type

The vertical or down blow type is very well suited to large areas at a fairly high level. These heaters are not much higher in cost than the propeller type, and at high levels do a much better job of floor coverage with the same size unit. Each heater covers a



Propeller type heaters used where location is relatively low.

given area independently and does not require that adjacent heaters be running to maintain air and heat distribution. They are manufactured in various sizes from 50,000 to as high as 550,000 Btu per hr, with a base rating of 2 lb steam pressure and 60F entering air temperature. These heaters also distribute their output of heat over a complete circle or along an aisle-way or outside wall, as required. This is easily accomplished by the type of outlet installed.

When the down blow heater is required to cover a large area from a central point and an adjustable blade diffuser is used, there are, as a rule, no objectionable blasts on the men in the working area and consequently fewer complaints.

One manufacturer of vertical down blow heaters has developed a unique method of using a somewhat conventional outlet. This outlet has been motorized by a small damper motor which is belted to the outlet in such a manner that it revolves once every two minutes whenever the heater is in operation. This type of outlet is particularly adaptable for very high mounting. A very high outlet velocity can be used because the air discharge passes across the workmen only once every two minutes. High outlet velocity means that the engineer can mount the heaters in the trusses and be sure to get the heated air down to the working area.

Popularity of the vertical type of heater has advanced to a point where it is now one of the most widely used types of heating equipment, particularly for large factory buildings, hangars and other large areas.

Blower Type

The blower type of unit heater has been and still is one of the old standbys for certain uses in the heating industry. It was one of the earliest heaters manufactured and still is widely used for the heating of certain areas.

There are one or two good reasons why the blower type has been used less frequently for general factory heating systems. In the first place, the units are more costly than other types and use more material for a given output. Also, though they deliver heat to the floor when mounted in the trusses, their discharge outlets are usually three or four in number and discharge the air in a comparatively compact area. This causes discomfort to workers who are directly in the path of the discharge.

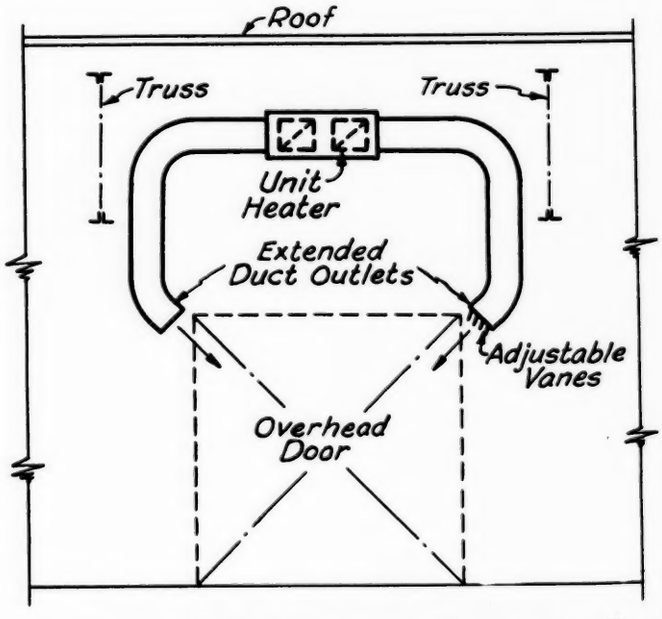
Blower type heaters are still ideal when it is required to take air from the floor, to use outside air for make-up, to blanket large doorways, or to heat loading docks.

They have no peers when a curtain of air across a truck or railroad door is required for rapid and effective dissipation of the inrush of cold air. They do a particularly excellent job when it is necessary to extend duct outlets from the heater down to a point immediately over a door or whenever some static pressure is required.

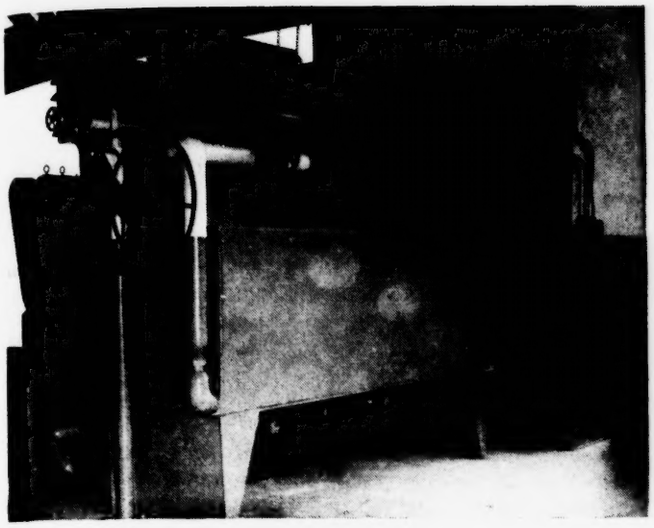
Steam Pressure – Final Temperature

After the designing engineer has decided what type of heater he proposes to use, and its location, his next problem is what steam pressure to use and what maximum outlet temperature can be used for a good job of heat distribution at the floor or breathing line.

There are several factors which enter into his selection of steam pressure. First, is there any exhaust steam available for use in the heaters? If so, at what pressure is it available? Next, what pressure will keep the original cost of the installation at a minimum? This is an important point when a very large project is being considered.. Other items he has to consider



One method of using overhead mounted unit heater at door.



Blower type, floor mounted heater at large door opening.

are what outlet temperature can be used with safety, and what stock unit heaters are available for the temperature and pressures he proposes to use.

Taking a look at the pressure angle, we first find that there are very few manufacturers who make a heater which will hold the outlet temperature down to a maximum of 130F, which we feel from our experience is as high as you can go and deliver the air to the working zone effectively. For this reason, and to get a larger selection of heater manufacturers to figure the job, we feel that an average steam pressure of 30 lb per sq in. is a very economical pressure to use.

With this pressure, which you may call either medium or high, heaters of several manufacturers can be purchased which will meet the requirements of the job; namely, 30 lb steam, 70F entering air and a maximum of 130F outlet temperature.

Exhaust Steam

In the average, fair-sized, new manufacturing project with which we have to deal, there is usually considerable exhaust steam available for heating from the engines, boiler feed pumps, air compressors, etc., and if the boilers are operated at 175 lb pressure or higher, the steam can be bled off at 30 lb back pressure for heating purposes.

With this 30 lb pressure to start with, we can figure, say a ten pound drop between the Boiler House and the last unit heater 1000 ft away and still have an average of 25 lb in the heaters. With this pressure and drop to work with, the average size steam main branch will be 4 in. at the point of connection to the main line and drop in size to 2 in. at the last heater. This gives an average size of 3 in. for the branch, with say a length of 500 ft equivalent.

For the entire job, covering say 500,000 sq ft of factory area with an average height of 25 ft, the heating load would be about 40,000 lb per hr. This would require a supply header of approximately 10 in. in size.

However, if a low pressure system were used with the back pressure exhaust steam at 10 lb pressure, a much larger main header would be required and the branch mains greater in size. For the same loads as stated above, the main header would be approximately 16 in. and the branches from 6 in. to 3½ in., or an average of 4 in. in size. The unit heater connections would be larger, including the valves and usually the heater itself is one size larger than with the 30 lb system. The covering would be considerably higher in cost due to the larger mains.

Condensate

The return lines for these systems reflect the same difference in size, and again it is in favor of the medium pressure system. The condensate temperature from the medium pressure system will be approximately 190F to 200F when the return lines are not covered, which is considered good practice, while the return temperature from the low pressure system will be 160F to 170F.

The condensate at either of these temperatures can be pumped without any difficulty. There is one other advantage which the 30 lb system has over the low pressure design and that is the fact that there is greater flexibility of design. With the low pressure system, the designing engineer has to watch the pitch of his pipe very carefully, particularly the return lines, as he cannot lift these lines by pressure, if necessary, as he can with the 30 lb system.

While on the subject of steam pressures, we may say a word about high pressure steam such as say 100 lb per sq in. There are one or two manufacturers who make their own coils for this pressure range and can deliver heaters which will meet the same requirements as the low or medium pressure heaters. However, use of heaters under ordinary circumstances at this pressure limits selection. Also, condensate is much harder to handle at high pressure and usually the life of the heater and piping equipment is somewhat less than can be expected with lower pressure. A practical use for high pressure steam in unit heaters is for commercial installations such as ovens, hot rooms, etc., where a particularly high temperature is required and height is not a factor. For applications of this kind high pressure steam is necessary and the condensate, which may run as high as 210F, can be cooled by heat exchangers or with condensing unit heaters before being returned to the central boiler plant by the condensate pump and receiver units.

Summarizing the above paragraphs, we find that for small buildings, stores, etc., low pressure steam is much more desirable than medium or high pressure, while for large factory buildings, particularly where back pressure steam is available, medium pressure of 30 lb is more practical than low pressure steam and will average about 15% less for installation. The life of medium pressure equipment is approximately the same as that of a low pressure system. If you are dealing with a large building of say 500,000 sq ft, the saving in original installation of a 30 lb system would be such that the designing engineer could hardly afford not to advise his client of its use.

Possibilities for Heat Pump Expansion

E. N. KEMLER

Acting Director of Research and Research Professor of Mechanical Engineering, College of Engineering, New York University

Discussion of the manner in which application, energy source, type of system, cycle, heat source and distribution enter into the future of the heat pump

THE heat pump as a device for the home is a natural development to meet continued improvement in our standards of living. The heat pump makes possible to the home owner an automatic year 'round comfort producing machine using one unit of equipment. The fact that it performs both the heating and cooling function justifies the increased cost of the equipment. Basically the heat pump as a year-'round device offers entirely new concepts of home construction and design.

So much has been written recently about the heat pump that those who have not given the subject much thought may have the idea that it has been fully covered. Actually, the general discussions to date have covered only a few of the many possibilities of this device. A general picture of its possibilities can best be presented by consideration of the many basic factors involved.

Table 1 presents some of the major factors which enter into the overall picture. While many other features enter into particular designs, such as mechanical cycles, those listed are currently considered the more important at this stage of development. Each of the factors listed can likewise be sub-divided into many further combinations or possibilities. This almost endless series of possible combinations of major features is one of the most encouraging factors in the future of the heat pump. It does, however, complicate development in that it is necessary to select a program of progress, without experimental basis or in some cases even theoretical foundation. While some features such as heat source still remain a problem in the economic development, again the endless possibilities leave no doubt but that some source or combination will lead to a simple and economical design.

Application

First among these factors is the type of application. Applications can be roughly divided into residential, commercial and industrial. The residential group is characterized by the type of equipment. For any general residential usage it is essential that the equipment be of a package type and that it be automatic in operation. Since it must be moved into the home, the size and weight of the package unit must be suitable to move through doors and up or down stairs. Some idea as to the sizes of equipment adaptable to residential uses is given by the dimensions of the Marvair unit manufactured by Muncie Gear Works, Muncie, Indiana, as shown in Table 2. Fig. 1, a typical residential installation of a Marvair unit shows that the unit is made in two parts. The left hand unit includes the fan and filter unit while the right hand unit contains the heat pump proper.

Units of this type can be made as automatic as conditions require. From the standpoint of simplicity of control equipment, manually operated valves can be used for changing from heating to cooling. The changeover requires closing two valves and opening two valves. Automatic operation, can be obtained by use of four solenoid operated valves and a further simplification is possible through developments now under way which use a single solenoid operated 4-way valve.

The electrically operated heat pump requires use of high priced energy so that every practical means of reducing energy requirements, through complete insulation for example, are necessary to make the heat pump economically competitive. This latter factor is, however, of secondary importance at this time since the type of service is in itself not competitive. Perhaps through taking advantage of the flexibility of construction, savings can be made which will offset some of the added initial cost. Also savings in cleaning bills and other similar costs may likewise offset some of the increased operating costs.

In addition, the heat pump system is susceptible to use of such accessories as electrostatic dust precipitators and germicidal lamps. Any attempt to express the so-called luxury features offered by the heat pump in terms of cost is impossible.

One important problem on which no information is

Table 1 — Factors of Heat Pump Operation

Application	Basic Energy Source	Type of System	Heat Source	Distribution System	Type of Cycle
Residential	Electricity Gas	Vapor	Earth Water	Forced air Radiant heat. (water)	Basic cycle Staged system
Commercial	Oil	Air	Air	Radiant heat. (air)	Basic cycle and storage
Industrial	Coal	Absorption	Other	Forced air and radiant heat.	Basic cycle and supplemental heat.

available is the effect of summer air conditioning, particularly in the home, on health as well as comfort. Little information is available on either of these factors and while the fields are difficult to analyze and study, information on them is needed both with regard to home and factory. A study by Huntington on Weather and Health in New York City published in Bulletin No. 75 of the National Research Council gives some information on daily deaths versus temperature. The interpretation of such information is quite difficult because of the many variables involved, and to conclude from these curves that temperature was the sole factor involved would certainly be an error. Data shown in Fig. 2 are included not in an attempt to show that deaths are directly correlated with temperature but rather to indicate that daily temperature may have some relation to health as well as comfort. This presents a difficult but important field for further study.

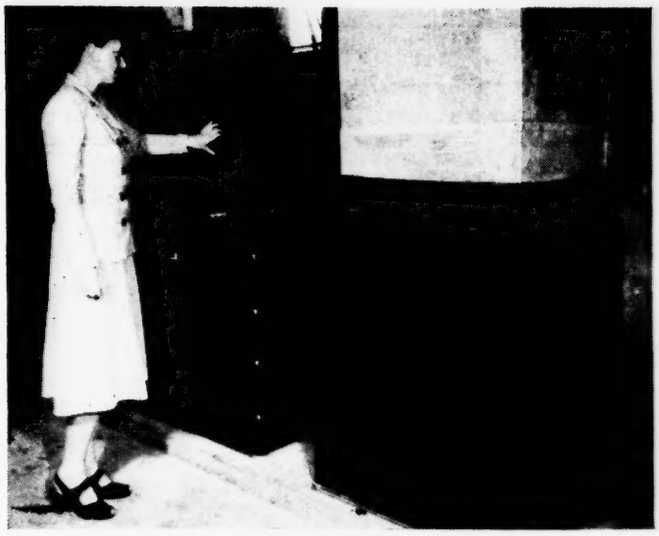


Fig. 1. Typical Marvair installation in a residence.

Commercial Installations

The commercial type installation is considered to cover the type of unit that can be adapted to heating and cooling small stores, apartment buildings, or office buildings. In general, size requirements for these installations are not quite so stringent as in the residential types although capacity requirements are generally considerably larger. There are also other limitations relative to heat sources that influence the type of equipment that can be used.

In small sizes, the commercial unit can be packaged as has been demonstrated by the Airtopia unit, Fig. 3, of Drayer-Hanson Co. This unit is made in capacity sizes which will fit residential uses but is larger than can be conveniently installed in most houses. The dimensions of these units are listed in Table 3. These units which utilize air as the source of heat, and have certain advantages which will be discussed later under heat sources, are completely automatic both with respect to heating and cooling operations and to automatic starting and stopping.

In larger sizes the commercial unit can be sectionalized for ease of handling and installation. This type of unit will probably be limited by the size of hermetically sealed compressor units which will probably include up to 25 hp capacity. Custom built units of any size are possible, although units over 100 hp capacity will probably involve completely rotary types of equipment.

The use of the heat pump, whether electrically operated or utilizing some other basic energy source, will ultimately lead to lower costs through providing a higher load factor. Regardless of cost, within reasonable limits, this summer cooling must be provided if the business is to get customers. For commercial establishments, as in the home, it is not a question of cost but one of service rendered. If the service can be provided, there will be a market.

Industrial Field

Industrial applications of the heat pump are more difficult to point out. Any industrial process which utilizes heat at a low temperature and in considerable quantities, and which has a suitable heat source of the proper type and quantity, is a possible heat pump application. Most important among these applications are evaporation processes which, if the temperature range is adaptable, can be made to operate quite economically since most of the heat for evaporation can be recovered by condensation of the vapor evaporated. The heat pump is utilized to provide the temperature differential to make the heat transfer from the vapor being condensed to the fluid being evaporated. Such processes have been widely used in Switzerland where fuel costs have made necessary the introduction of more efficient methods than direct fired evaporation units.

Industrial applications of the heat pump generally involve large size units. Because of this, most of them employ some type of rotary compressor which when operated under designed conditions gives high efficiency, thereby making the overall process very efficient. The coefficient of performance, measured by the ratio of heating effect produced to the mechanical work required, falls between approximately 10 and 40. The actual value will depend upon the temperature differential necessary to effect the heat transfer required.

Table 2 — Size of Marvair Unit

Marvair, hp	Equipment Housing			Fan Housing			Capacity of Cycle	
	Width, in.	Length, in.	Height, in.	Width, in.	Length, in.	Height, in.	Heating	Cooling
							Btu per hr	
3	28	40	34	21¾	27	22	60,000	32,000
5	28	40	34	21¾	27	22	100,000	54,000

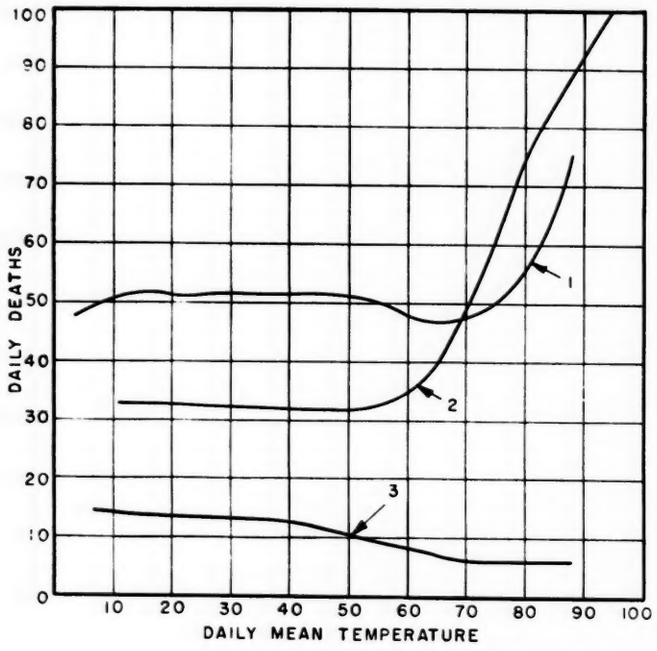


Fig. 2. Influence of temperature on health conditions.

Basic Energy

To date the heat pump has been almost exclusively associated with electrical energy as the basic energy source for operation of the system. Where available in a usable form and at a sufficiently attractive rate, electricity will continue to be an important factor in the development of the heat pump. For small units, particularly for residential use, it represents a very convenient and desirable energy source. As units become larger other basic energy means also need to be considered. For units in the size that can be driven by internal combustion engines, gas and oil in some form need to be considered. While coefficients of performance for such systems is considerably less than for electrically driven units, the performance possible is several times greater than that from direct combustion, insofar as heating is concerned and in addition, cooling can be obtained. While a coefficient of performance of 4 to 1 may be attained by an electrically operated unit, a value of 2 would be the corresponding performance to be expected of a gas or oil fuel engine operated unit. Where a value of 3 is obtained from an electrically driven unit, a corresponding value of 1.5 should be attained by the gas driven unit. This means a heat output of 1.5 times the fuel input or over twice the output of a conventional furnace. In addition to this reduction in fuel cost, cooling can be obtained. For equivalent heat outputs, the heat source requirements of the gas driven unit would be greatly reduced as compared with an electrically operated unit.

The gas or oil fuel driven units are obviously adaptable to commercial and industrial applications. Recent developments in the field of the coal burning gas turbine make this a very attractive possible use of coal in the heating and cooling field. By the use of an oversized combustion chamber, booster or supplementary heat, effects can be obtained with only slight decrease in overall performance. This possibility will be discussed in more detail later. There are many cases where the heat pump can justify its existence on a heating basis alone. The general trend to cooling both for commercial uses and in apartment buildings greatly increases the possible field of application. While each of the larger types of installations are judged on the basis of the particular economic conditions involved, general studies indicating limitations and possibilities would be most desirable. A considerable expansion of the heat pump field, taking into account other types of basic energy source, can be expected.

Type of System

The next basis of comparison of heat pump applications is the type of system which might be utilized. Again, most of the consideration to date has been given only to the conventional vapor compression refrigeration cycle. For most types of applications, particularly residential and many of the commercial and industrial applications, this type system would appear to be best adapted to give highest overall performance. It should be pointed out, however, that there are other types of systems which might be used.

The compressed air type of system, while perfectly feasible, has a small overall coefficient of performance because of the considerable amount of mechanical work necessary to raise temperatures sufficiently high to give reasonable heat exchanger surface. The overall performance of the system would be considerably below that of a vapor system operating between the same temperature limits.

The third type system which can be used is the absorption system such as is employed in the Servel year 'round unit. While the Servel unit employs the absorption cycle only for cooling, it can be adapted in connection with heating. Considering the many problems of adapting such a system to heating and cooling and the general low coefficient of performance which can

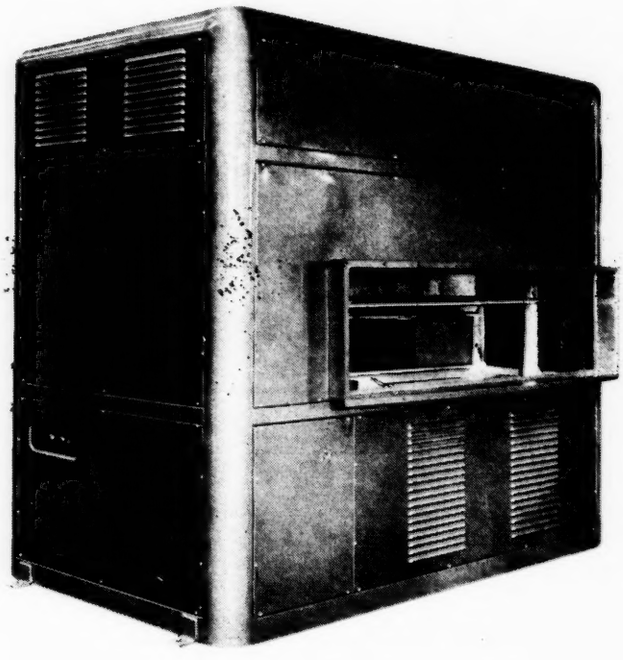


Fig. 3. Airtopia commercial unit. Dimensions are given in Table 3.

be obtained, development work has not been carried out on using this cycle for heat pump for both heating and cooling. It is possible that there are certain types of commercial and industrial applications where these last two types of systems might be used to advantage. Until more thoroughly investigated, they can not be completely disregarded.

The public in general is intrigued with the general idea of getting 3 or 4 Btu of heat for each Btu of electricity which is utilized in operating a heat pump. In some types of industrial processes the output divided by the electrical input may be of the order of 10 or 20 or more. However, we know from the law of conservation of energy that the energy supplied to the system equals the energy leaving so that the difference between the 4 Btu output and the 1 Btu input must come from some source. This, therefore, leads to a consideration of what is today the most important problem, insofar as the heat pump for residential and commercial usage is concerned. This problem is to find a suitable heat source in order to supply the other 3 Btu.

Considering for the moment only the residential type installation, air is the most easily accessible heat source. However, it has the disadvantage of being at a relatively low temperature in our northern areas when heat requirements are at a maximum. While the overall performance of a heat pump is very closely related to the temperature of the heat source, the air unit may give better performance when measured over the entire season than some other type of system, even though its performance under minimum operation conditions is relatively low. The most difficult problems in connection with utilization of air, are (1) problems such as eliminating frost from the outdoor air coil under conditions of relatively low temperature and high humidity, and (2) problems of capacity control with varying air temperature.

Table 3 — Dimensions and Capacities of Airtopia Unit

Dimensions

Airtopia Size, hp	Width, in.	Length, in.	Height, in.
3	41	62	73
5	47	82	74
7.5	59	97	79
10	69.5	99	88

Capacity

Airtopia Size, hp	Outside Air Temperature, F	Heating	Cooling
		Btu per hr	
3	30	34,600	
3	60	46,000	
3	80		38,000
3	100		36,500
5	30	58,000	
5	80		63,100
7.5	30	87,500	
7.5	80		96,000
10	30	116,000	
10	80		126,000

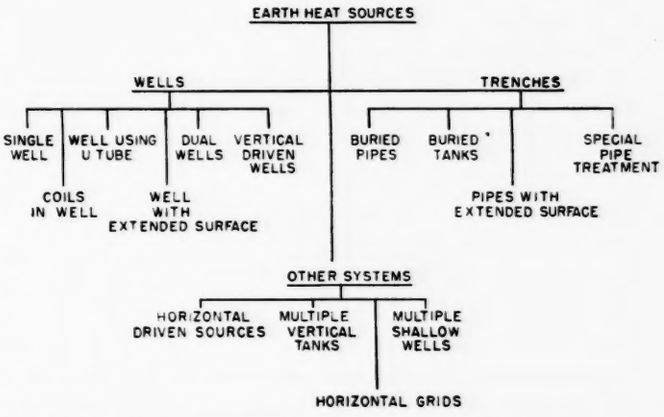


Fig. 4. Some possibilities for using earth heat sources.

The other generally acceptable heat source is the earth (H&V, Aug. 1947, p 70). In most areas it has a sufficiently high temperature to give relatively good heat pump performance. Fig. 4 indicates some of the possible means whereby heat might be abstracted from the earth. The generally successful method of utilizing a vertical hole in the ground, such as a well, from which heat, and not necessarily water, can be abstracted is one generally satisfactory method of obtaining the heat. This arrangement has the advantage of being able to supply heat at nearly uniform temperatures since the wells are below the level of seasonally varying earth temperature. The major disadvantage of such a system is cost.

In some localities drilling costs are relatively low. Perhaps if the heat pump were developed on a sufficiently broad basis, wells for the pumping of heat might still advance to the most desirable means.

While the general and continuous utilization of underground water for heat pump purposes is not feasible, considered on a long range basis, it is possible to utilize underground wells as a source of heat and to by-pass a small amount of water under peak requirements. This has the effect of increasing the heat producing capacity of the system at the expense of pumping a small amount of water. Inasmuch as the maximum capacity of a heating system is required only about 5% of the time, such by-passing under certain conditions would not be serious and might be a factor in realizing an economic heat source.

While water for general residential installations does not appear to be a practical solution, when used directly in the heat exchanger and discharged, there are many industrial and commercial applications where water might be used to advantage. Water sources for such applications include use of wells, lakes, rivers, and under some conditions even cooling towers. Other heat sources are possible, particularly in connection with industrial applications, where many new heat sources become available. Some of these applications are regenerative in type and at first glance

appear to be in the class of pulling one's self up by the boot straps. Because of the large economic advantages offered, such special heat sources need to be carefully investigated.

One of the most important factors needing study today insofar as future trends in heat pump developments is a general analysis of heat sources. There is only a very limited amount of information available both as to performance and requirements of heat sources. There is practically no information of a design nature which can be applied to heat pump applications. A general critical analysis of heat source possibilities, together with an experimental program to add physical information which could be used to formulate design information, would be valuable.

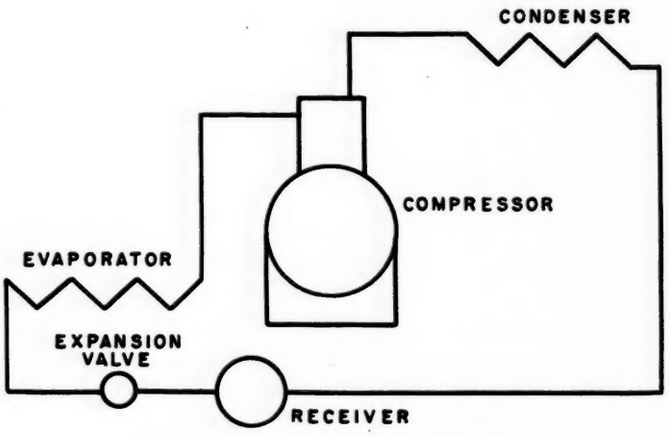


Fig. 5. Simple basic vapor cycle.

Heat pumps can also be considered on the basis of the type of distribution system, as applied to residential installations. Forced air systems have generally been considered as the most suitable and adaptable type of distribution system. If properly designed, the same system can be used for heating and cooling thereby giving certain definite economical advantages. Hot water systems do not appear to be at all practical with normal heat source available because of the high temperatures which are required for operation of the heating system and also because they are not adaptable to normal cooling requirements. Under the high temperatures necessary, the coefficients of performance would necessarily be very low.

The heat pump is very well adapted to radiant heating methods utilizing water, due to the relatively low temperatures at which this water is required. Because of the small size heat exchanger needed in water systems, an earth to water heat pump, utilizing radiant heating system, could be made very compact and simple. However, one of the disadvantages of such a system is its inability to furnish cooling to such a system. It is feasible, however, to utilize a radiant heating system using air, particularly if combined with some air circulation. By combining radiation with some air circulation, it is possible to accomplish better humidity control, and more important, to make attainable the utilization of cooling in the radiant system. This is possible because the circulated air can be dehumidified and humidity control maintained to make it practical to use radiant cooling. If radiant heating actually results in a reduction in maximum heat requirements for the same comfort, its utilization in connection with the heat pump would be of interest not only from a comfort standpoint, but from the standpoint of reducing the magnitude and requirements of the heat sources. This latter factor is most important.

Type of Cycle

As a final general basis for evaluation of the heat pump, the question of type of cycle needs to be considered. Under type of system it was pointed out that three basic cycles—vapor, air, or absorption could be utilized. The use of any one of these simple cycles results in the simplest type of heat pump. In order to obtain better performance under certain types of conditions, it might be possible to utilize staging.

Reference to Fig. 5 shows a simple basic vapor cycle. As the outside air and conditioned air pass over the heat exchangers, the outside air has its temperature reduced and the inside air has its temperature increased. It is necessary that all of the heat be pumped to the higher temperature. It is possible to reduce the heat pump power requirements and increase coefficient of performance by utilizing staging wherein half of the heat is pumped as high as needed to supply half of the heat and the remainder pumped the full distance. This amounts to the equivalent of pumping all of the heat to the average rather than the maximum. Fig. 6 shows basically how this can be accomplished. While this means introducing complications in the mechanical setup, it is possible to obtain substantially increased performance under certain conditions particularly

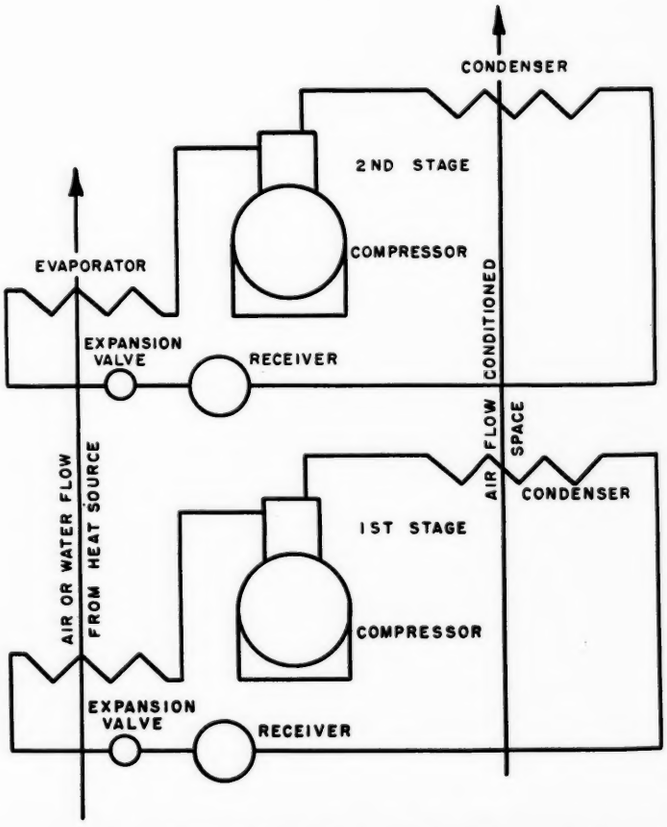


Fig. 6. Method of reducing power requirements by utilizing staging.

where high temperatures are encountered such as in water heating and similar systems.

The second modification of the basic cycle is to utilize a heat pump plus heat storage. Inasmuch as the maximum capacity of any heating system is required for only a very short amount of the annual heating season, it is possible to reduce the size of the equipment quite appreciably if the maximum demand can be made through some means such as heat storage. While storage is not a simple matter, the advantages which it offers, both with regard to the reduced size of equipment and improved general performance, makes it worthy of study. The reduction of size of equipment has, of course, an immediate influence on the initial investment. From the standpoint of the power companies it means generally better load factors, contributing in the long run to lower power rates and better operation; also it reduces the peak requirements which the heat source must supply making it possible to reduce the amount of surface, hence the cost of the heat source. In general, any change such as heat storage, which would reduce peak requirements, has many economical advantages, particuarly when applied to the heat pump.

Another modification having an effect similar to heat storage is to utilize supplementary heat in connection with the basic heat pump cycle. Again the supplementary heat would be utilized to supply the maximum requirements which occur perhaps only 5% of the time. If this would permit reduction, for example, of heat pump size from 5 hp to 3 hp, it would mean a very substantial reduction in cost of equipment and in size of the heat source needed. Supplementary heat might take the form of electricity, natural gas, propane, city water, and many other means. While it adds some complexity to the system, if it can be economically and simply developed, it might mean greatly reduced overall cost.

This discussion of the heat pump has been from a very broad viewpoint. When the various possible combinations of basic elements involved are considered separately, it can be seen that a heat pump is something more than just a simple refrigeration machine adapted to do heating or cooling. It must be further remembered that this discussion has not considered the mechanical details of the heat pump design. Here again there are almost endless possibilities and combinations of basic elements. In the air to air unit, for example, there are many possible means of defrosting and capacity modulation that can result in quite different types of units. Variations in means of control, and means of switching or reversing the cycle also influence the overall design. Likewise the mechanical heat pump cycle itself can take on various forms depending on types and arrangement of heat exchangers, piping, and valves. Heat may be picked up from the heat source through either direct expansion or indirect means. There are perhaps as many possible combinations of basic mechanical elements as there are of overall application factors just discussed.

This utilization of the heat pump to produce multiple functions may some day deserve consideration. Until more experience has been accumulated on the fundamental type of unit, the building of units to do household refrigeration and household hot water heating, home heating and cooling, plus hot water heating and similar combination functions should not be attempted. In industrial applications there are many possible uses where dual functions can be accomplished.

Most new developments such as the heat pump follow a pattern where certain specific mechanical, sales or application problems have to be solved before the development can proceed. The heat pump, while it has specific problems needing solution, offers so many general approaches to residential, commercial and industrial applications, that it is difficult to outline general solutions, starting places and programs for rational development.

Navy Man's Baby Has Air Conditioned Crib

Robert Schneider of East Braintree, Mass., a navy veteran, has built for his daughter, Robin Ann, now about a year old, her own private, air conditioned apartment providing constant temperature summer and winter with humidity control, making blankets unnecessary, and with a plastic thread sheet that eliminates laundering and frequent changing. It is a little enclosed structure with a 4-ft by 28-in picture window that enables the infant to have her own outlook on life without danger of tumbling out. Carol (Mrs.) Schneider did most of the drafing and "Bob" did the construction work in the cellar of their apartment house home. Now Robin Ann spends most of the cold evenings in her own version of the "New Look" for winter in New England—a pair of diapers with a constant temperature of between 68 and 70F without danger of a draft even though her parents may open a window of their bedroom. Should the temperature go below 72F an alarm connected with a buzzer alongside her parents' bed would sound. The alarm system is controlled by dry cells and would continue to function even if the electric current of the house were shut off. Since heat for the crib is provided by 100 watt bar type elements similar to those used for chicken brooders, it cannot rise dangerously high. Humidity and temperature are controlled by a chicken brooder thermostat obtained from a mail order house. The crib has duplicate heating systems, so that if one fails the other will continue to function.

—F. N. Hollingsworth.

Charts to Obtain Solar Altitudes and Azimuths

IRVING F. HAND
Blue Hill Observatory, Milton, Mass.

A group of polar coordinate charts for obtaining the position of the sun for any minute of the day within continental United States.

A SET of charts, Fig. 1-4, are presented to permit instant visualization of the diurnal march of the sun across the sky. Before examining these charts, let us consider definitions of some of the basic terms.

Solar altitude is the angular elevation of the sun above the true horizon.

Solar azimuth is the arc of the horizon intercepted between a given point and an adopted zero point.

Solar declination is the angular distance of the sun north or south of the celestial equator. In the northern hemisphere this declination is 0° at the time of the equinoxes; at the summer and winter solstice, + 23° 27′ and —23°27′, respectively.

Equinox, occuring twice each year, is the moment when the center of the sun crosses the celestial equator and the day and night everywhere on the earth are of equal length periods or in other words, 12 hours.

Solstices are points on the apparent path of the sun, midway between the equinoxes, where the sun attains the greatest values of north and south declinations.

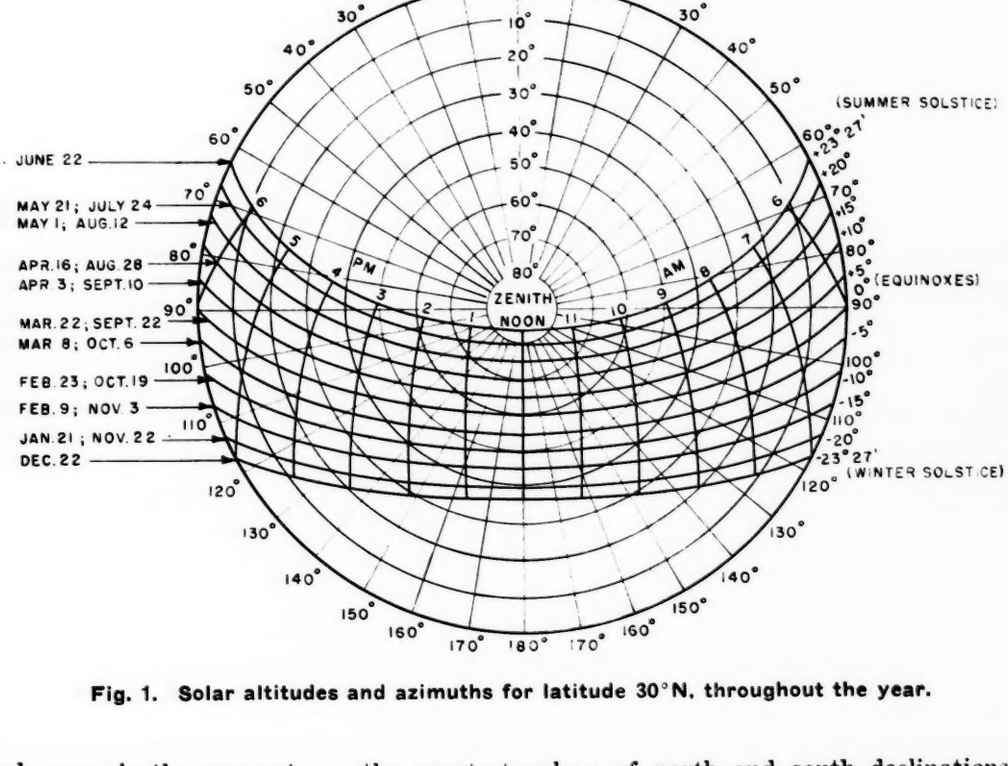


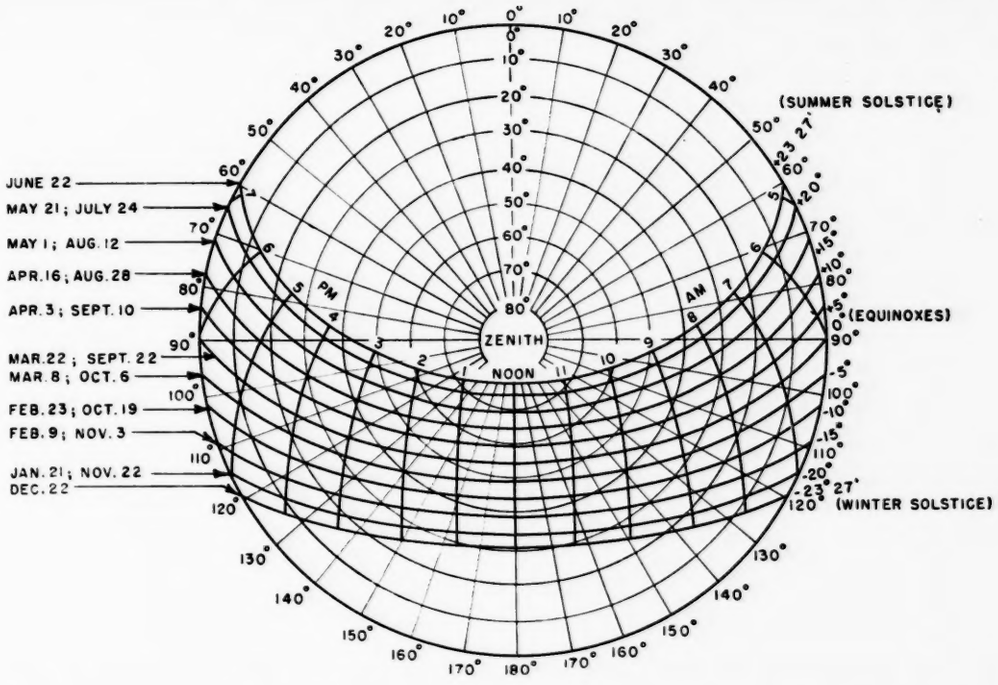
Fig. 1. Solar altitudes and azimuths for latitude 30°N. throughout the year.

The mid-point on the charts represents the zenith; the outer circle the horizon. Solar altitudes from 10°

Table 1—Average Dates Corresponding to Solar Declinations

Declination Positive, Degrees	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23.45
Dates	March					April										May							June		
	21	23	26	28	31	3	5	8	11	13	16	19	22	25	28	1	5	8	12	16	21	26	1	10	22
	September									August										July					
	23	21	18	16	13	10	8	5	2	30	28	25	22	19	16	12	9	5	2	28	24	19	12	3	
Declination Negative, Degrees	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23.45
Dates	September				October											November							December		
	23	26	28	1	4	6	9	11	14	17	19	22	25	28	31	3	6	10	14	17	22	27	3	11	22
	March									February										January					
	21	18	16	13	11	8	6	3	1	26	23	20	18	15	12	9	5	2		29	25	21	16	10	2

Fig. 2. Solar altitudes and azimuths for latitude 36°N, throughout the year.



to 80° inclusive are shown by the inner circles. The radial lines indicate solar azimuths in 10° steps; North = 0°, azimuth east in a.m., west in p.m.

Lines indicating the equinoxes, solstices, and days with solar declinations of —20°, —15°, —10°, —5°, +5°, +10°, +15° and +20° are crossed by hourly time-lines. The average declinations of the sun and the average dates of these declinations appear at the ends of the declination lines.

Except when the change in solar declination is very small at the time of the solstices, or near aphelion and perihelion (points of earth's orbit, respectively, most distant and nearest to the sun), the difference in time between the lines averages about 15 days, thereby justifying the use of declination lines rather than lines for the midday of each month. Close approximation of the position of the sun for any minute of any day within continental United States usually may be accomplished within an accuracy of plus or minus one degree of solar altitude and azimuth. For more precise determinations, any tables of solar altitudes and azimuths may be used, as for example, those in HEATING AND VENTILATING, December, 1947, pages 81-83.

True solar time is used on all the charts; therefore *standard time* must be converted to *true solar time* before making calculations through the use of either the charts or tables. The corrections to apply to *standard time* to convert it to *true solar time* are made up of two values, one of which is constant for any given location. First, the constant correction for difference in longitude between the site and its standard meridian is determined by allowing one minute of time for each quarter degree difference in longitude. The correction is plus if the station is east of the meridian

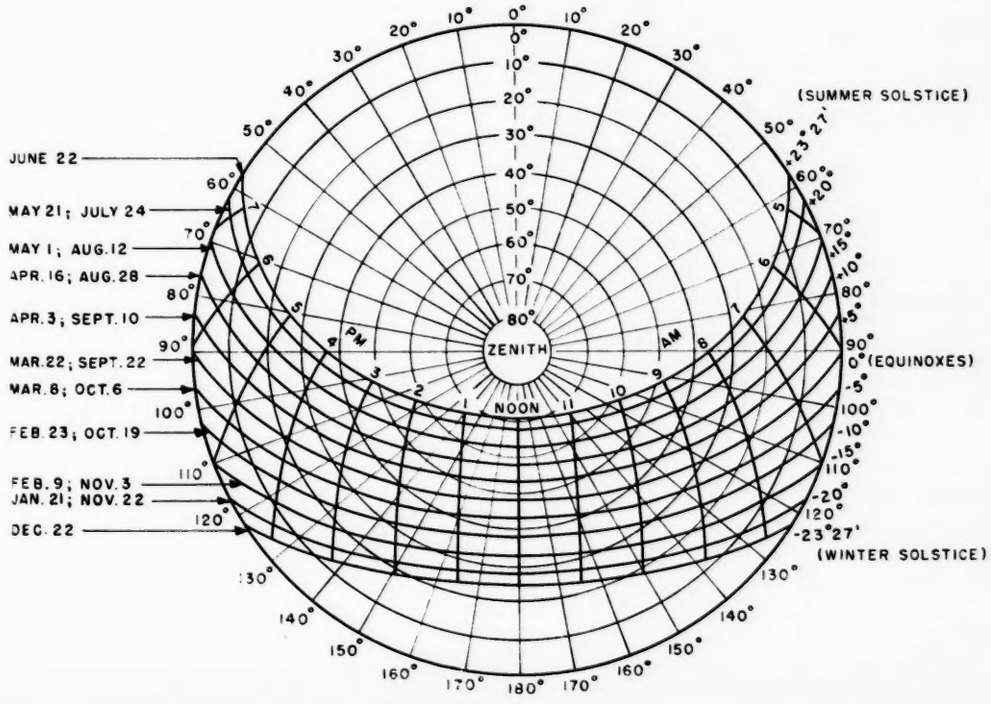


Fig. 3. Solar altitudes and azimuths for latitude 42°N, throughout the year.

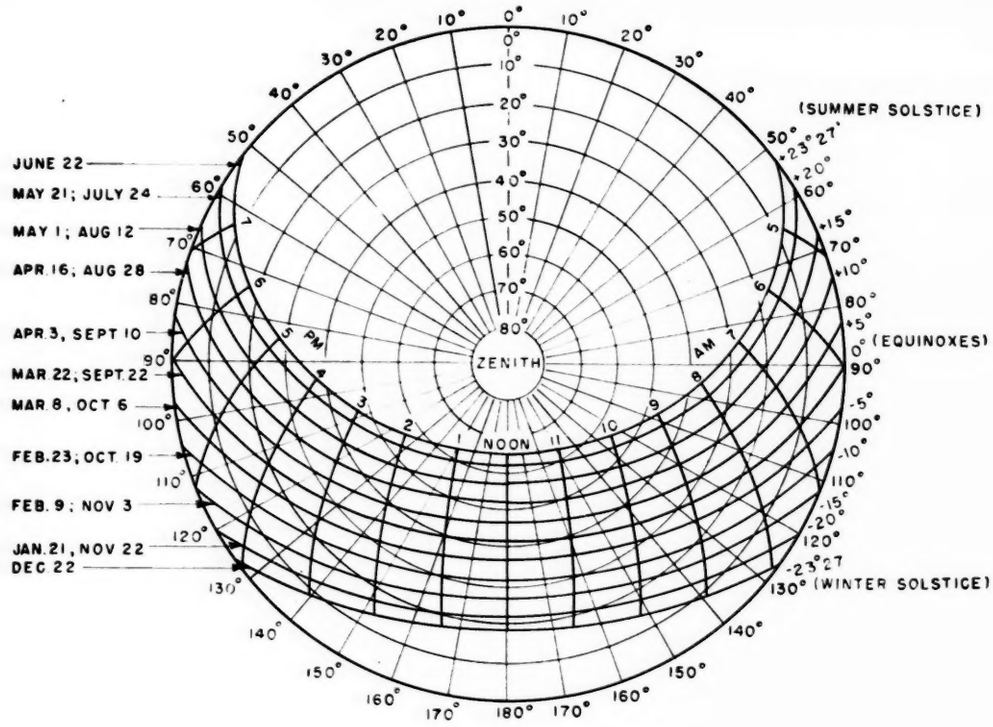
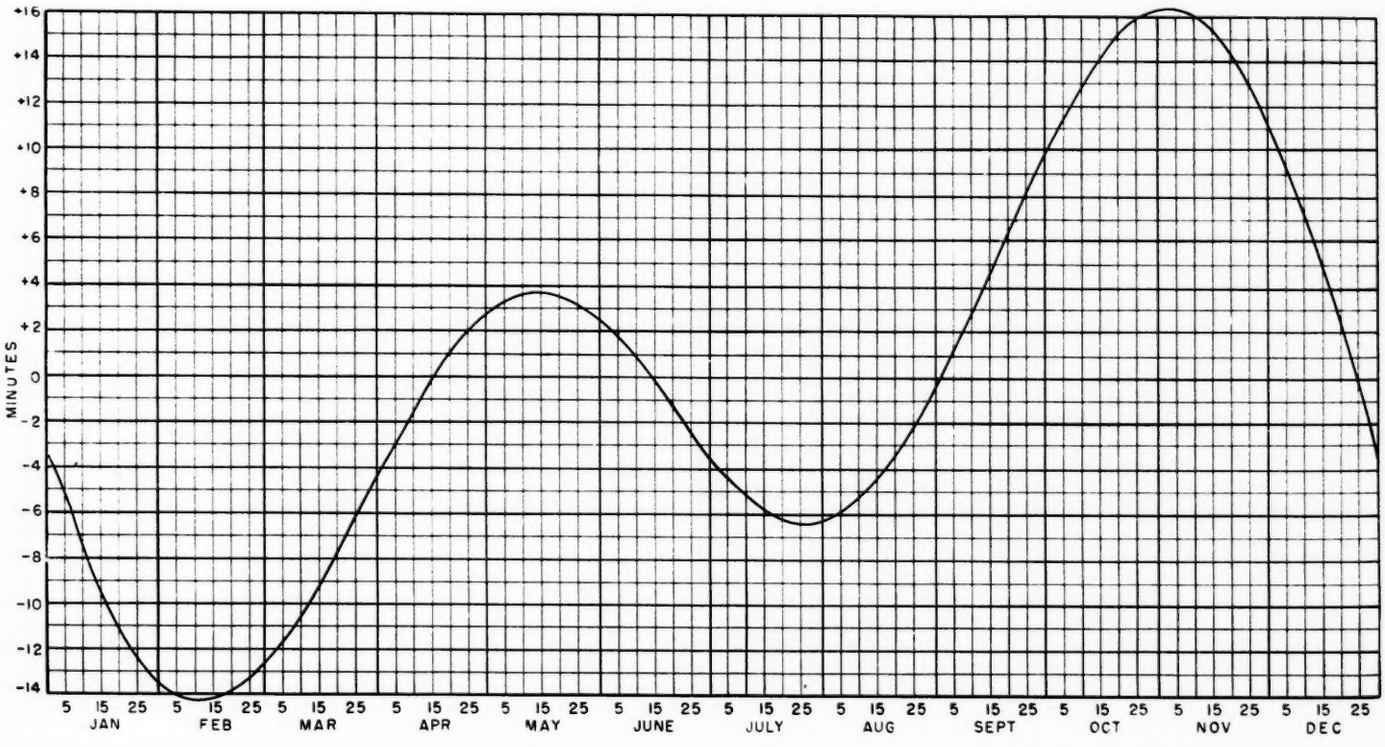


Fig. 4. Solar altitudes and azimuths for latitude 48°N, throughout the year.

Fig. 5, below. Equation of time—apparent minus mean.



and minus if west. The constant correction then is added algebraically to the correction for the equation of time as obtained from Fig. 5.

For example, let us assume that we wish to determine the position of the sun at 9:00 a.m., *standard time*, at latitude 42°04'N, and longitude 96°41'W on May 1. This site is 6¾ degrees west of the 90th meridian. The constant correction for longitude is —27 minutes. Consulting Fig. 5 we find that the value of the equation of time on May 1 is plus three minutes. Adding algebraically, we obtain —24 as the value in minutes to apply to 9:00 algebraically, giving 8:36 a.m. as the *true solar time*.

Counting up the altitude lines on Fig. 3 from the outer circle to a point 0.6 (36/60 of the distance between the 8:00 and 9:00 a.m. lines on the May 1, or 15° declination line, we locate this point at approximately 39°. This same point of intersection falls on the 106° azimuth line.

Determinations for latitudes other than shown directly on the charts require two calculations with interpolations between the results. If, for example, we wish to find the position of the sun at 9:00 a.m. at latitude 39°N., we must determine its position at latitudes 36°N and 42°N and take the mean of the two values.

The use of the Table 1 will increase the accuracy of the calculations.

Let a Ventilating Job Find Itself

T. W. REYNOLDS
Chief, Air Conditioning Division, Abbott, Merkt & Co., New York

ONCE the writer has set down the "cfm" at each outlet on the air conditioning plans he does not worry about it any more. Let the contractor do that if he wants to and he may want to do a lot of testing and adjusting of the final installation, now that most contractors are on a cost plus basis. As for the writer, this is not as important to him as it once was, for he has long since found out that it is only an approximate guide. For example, suppose an outlet is not adjusted and only delivers 100 cfm where 125 cfm was called for on the plan. If the occupant of the space is comfortable, what difference does it make what the plan called for. If the air flow from the outlet has been laboriously adjusted for 125 cfm it might no doubt have to be eventually readjusted for 100 cfm or some other quantity.

Someone may comment adversely on this by saying the engineer does not know his calculations, but that is not the reason for the wrong air quantity. The wise engineer knows his calculation only too well and is not misled by them. He knows that there are just too many darn variables for him to get each answer right each time. He knows that it is better to provide flexibility and reserve in his design, so that adjustments can be made where and as desired at some later date.

The engineer knows that he can then borrow from Peter to pay Paul, and that he would eventually have to do so anyway, no matter how precise his calculations were. He has learned that someone may put more lights, people, or other heat gain in the space or else do some other thing which the job was not calculated to handle, and that someone will always be doing this throughout the years. For example, on one store installation just completed, the management is going around cutting out lights to an overall extent of about 30%. On top of this, the number of customers has not materialized to the extent anticipated.

The best way is to let the job find itself and then go around and make what adjustments are necessary to overcome complaints. The writer has spent days of hard work taking readings, making adjustments over and over, and has finally balanced more than one job, yet fails to see that they gave any more satisfaction than the ones which were more lightly passed over without much in the way of adjustment to suit the cfm called for on the plans. He has also learned that adjusting the air delivery to a space to suit an occupant of that space is no guarantee that it will not have to be readjusted for the next occupant that moves into the same space. If there is a thin and dominant person in the space, the space will have to be kept warm; on the other hand if the squad boss of the space is fat, the space will have to be kept cool regardless of how all the thin ones feel about it.

If the make or type of air filters is changed, say from throwaway to renewable filters, their resistance to air flow may be greater or less than originally allowed for when computing the static pressure of the system. If this be the case, then there will be changes in the quantity of air delivered by the system, even as there will be with no change in filters, but with filters clogged with dirt.

Quantity of air delivered is affected by still other factors. Someone either shuts off or slows down one or more exhaust fans, or in time adds a fan or so, either supply or exhaust. Someone else varies the position of the outdoor air dampers, so that pressure within the space varies. Due to conditions such as these or to changes in physical conditions of the space, air may return to the cooling units by other than the planned route. In passing some occupied space the return air may gang up, so to speak, with resulting volume so great as to be drafty. With converse effect it may pick up too much heat gain as it travels along too many sunny windows before finally finding an exit at some door or outlet to the general interior space.

One may find that the number and points of air return by way of stairways, doors or other passages have been changed; doors may be installed on openings, or doors which were planned to be left normally open or closed, may be found contrariwise. When and where these things occur, there must be suitable changes in the air quantities at the outlets.

Where ceiling outlets have been selected of a size which gives air velocities too close to recommended minimums or maximums, any material change in air volume will cause the outlets to be noisy, if with air velocities above the maximum; drafty, if with air velocities below the minimum. Too low an exit velocity will cause air to drop more or less directly down from an outlet. Any consequent dampering down of one outlet without due study and regard as to the effect on nearby outlets will cause too much of the air to be passed on to some other outlet or outlets.

With time the evils grow as more and more outlets are partially or entirely closed against the excess and drafty air. In this way the entire system becomes out of balance, but this bad thing is good for by now correction can best be made by opening wide all outlets and starting new with adjustment only at outlets serving areas from which complaints are received. Regardless of what happens, it is best with any system to open wide the system at reasonable lapses of time and to then adjust the flow from outlets as required by accumulated changes over the period of time.

The exact position of the outdoor and recirculating dampers when the readings at outlets were taken is still another factor affecting the value of any records as to air quantities at outlets. Dampers vary automatically, changing resistances and air flow. But even

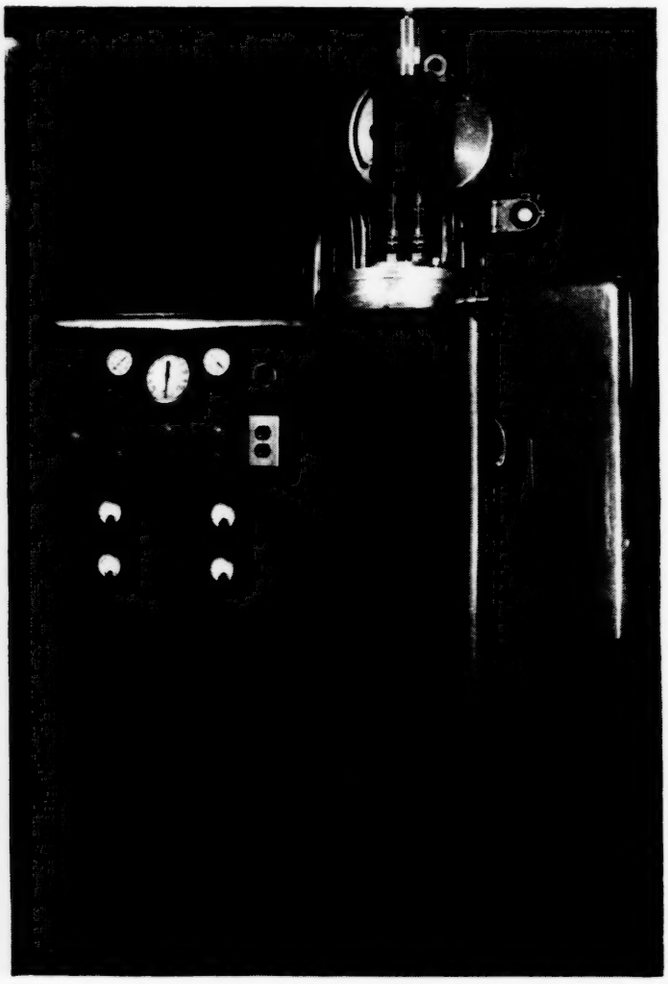
with dampers of fixed position, the air quantities from a ceiling outlet will be measured with a substantial difference by two different readers. One's own readings taken but a few minutes apart as a check agree but seldom, and then no doubt only in the sum total of quarter point readings within the circular outlet. It is possible that at times the plus and minus errors or variations in the readings at the quarter points may be compensating.

With the best of methods, care and instruments, readings at ceiling outlets are still not all that might be desired. One starts out with zeal and care, but interest lags with long continued contact with cold supply air from the duct, air not as yet mixed with room air. All these things, together with weariness and monotony of innumerable readings taken in awkward positions over one's head on uninteresting outlets, do not lead to accuracy.

New Device for Obtaining Absolute Zero

Low temperatures are essential for much research directed toward a better understanding of the properties of matter. Research at extremely low temperatures, however, has been much hampered by the fact that the scientist has been forced to devote much of his attention to the problem of reaching the low temperatures. Recently developed is a unit of standard equipment for this purpose, the Collins Helium Cryostat.

This Cryostat is a relatively simple device which liquefies helium and can maintain any temperatures down to 2 degrees Kelvin, or 456 degrees below zero F. This device is the invention of Dr. Samuel Collins of the Massachusetts Institute of Technology and is now being produced by Arthur D. Little, Inc., an industrial research organization of Cambridge, Mass. Previous to Dr. Collins' invention there have been only four helium-liquefying installations in North America, all designed and built by the laboratories using them and requiring an expensive cascade system of refrigeration. The first of the Collins Cryostats went into use in 1947 and there are now seven in operation.



The Collins Cryostat Cabinet

The cold space of the Collins Cryostat and part of the refrigerating equipment is contained within a steel vacuum jacket 12 in. in diameter and about five feet tall, which is housed within a cabinet. Other equipment includes a 1-hp compressor and a low-pressure gas holder. The complete unit weighs 2800 lb and occupies less than 50 sq ft of floor space. Helium is the only refrigerant used. Liquid helium or other liquefied gas can be removed from the equipment.

Dr. H. O. McMahon, who had cooperated with Dr. Collins in the original work, also participated in the improved design. Among features developed under his guidance is a means for compressing helium in ordinary lubricated compressors without contamination.

For experiments outside the test compartment, which is four inches in diameter by eight inches high, an auxiliary coil serves to liquefy any gas, depending upon the temperature level desired. The Cryostat, without any auxiliary refrigeration, will liquefy helium at the rate of one liter per hour. This rate can be doubled by using liquid nitrogen in a special precooling coil.

The cycle used by the Collins Helium Cryostat includes innovations which make the apparatus comparatively simple and safe. Helium is the only circulating gas and the maximum pressure used is only 215 lb per sq in. Recirculation of the helium is constant and without contamination.

Accessory components include a special liquid-nitrogen charcoal trap for purification of the initial and make-up helium at high pressure; a specially fitted compressor for compression of the helium in the circulating circuit; a helium holder to store low pressure helium; a built-in hoist for servicing the internal parts of the liquefier, vacuum pumps and ionization gauge for control of the vacuum jackets; a helium thermometer and an assortment of pressure gauges and various overload and safety devices.

Using a 10-hp motor, the compressor weighs approximately 1100 pounds. It delivers about 25 standard cubic feet per minute of helium compressed in four stages to about 200 lb per sq in.—*F. N. Hollingsworth.*

Joints for Transite Pipe

J. E. YORK
Building Service Engineer, Stone & Webster Engineering Corp.

Description of couplings for joining Transite pipe both for overhead pressure lines and underground lines.

TRANSITE which is composed of two durable materials, asbestos fiber and cement, is widely used for vents, ducts and stacks. It is corrosion resistant, has a low coefficient of friction, low heat conductivity, high temperature resistance up to 700F and is usually furnished in Class S pipe for this type of service. It can be obtained in standard pipe sizes from 2 to 36 in. diameter and in lengths from 10 to 13 ft with plain ends, machined or tapered ends.

Joints between adjacent sections of pipe may be made in several ways to be described.

Sleeve and Heavy Sleeve Couplings

The sleeve coupling, Fig. 1*a*, and a heavy sleeve coupling, Fig. 1*b*, each consist of loose fitting Transite collars calked in place over the pipe sections with Johns-Manville No. 4196 asbestos rope and a joint compound.

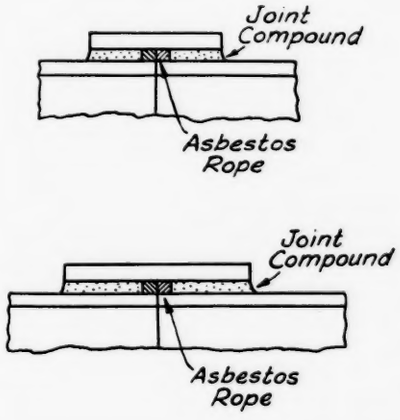


Fig. 1a (upper). Transite sleeve coupling. Fig. 1b (lower). Heavy sleeve coupling.

Sections of pipe jointed together with these couplings are not machined and consequently cut sections can be quickly assembled. This type joint may be used for all installations where internal air pressure whether negative or positive, does not exceed 16 in. of water.

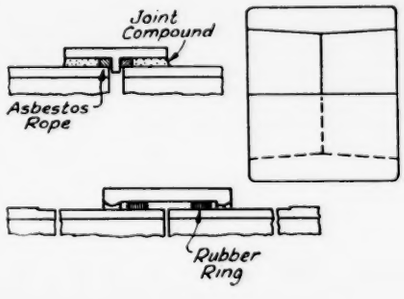


Fig. 2, upper left. Ribbed coupling. Fig. 3, lower. Simplex coupling. Fig. 4, right. Tapered coupling.

Heavy sleeve couplings are designed for use where high flexural strength must be developed at the joints for locations where the coupled pipeline must act as a continuous beam. For couplings used in such service, a sulfur base joint compound should be used. J. M. Flue Pipe Cement, and J. M. Chemstone Cement are commonly used for joint compounds for regular sleeve couplings.

Ribbed Couplings

The ribbed coupling, Fig. 2, provides a stop which facilitates the yarning operation and insures the coupling being located evenly over the ends of the pipe without the necessity of marking the ends. In other respects this joint is the same as the ones illustrated in Fig. 1.

Simplex Couplings

The Simplex coupling, Fig. 3, consists of a Transite sleeve drawn over two rubber rings during the assembly operation. This type joint may be used on all sizes of pipe for installations where the internal air pressure, negative or positive, is greater than 16 in. of water. The service limits of this coupling are: Negative air pressure 30 in. of water; positive air pressure 150 in. of water; temperature 150F.

A hydraulic coupling puller is ordinarily used for assembling this joint.

Tapered Couplings

The tapered coupling, used with tapered end pipe as shown in Fig. 4, is made in standard pipe sizes from 2 to 12 in. diameter and may be used for installations where the internal air pressure, negative or positive, does not exceed 16 in. of water. This type joint may be quickly assembled by hand with pipe having the ends tapered.

Duplex Couplings

Where pipe with tapered ends must be cut in the field leaving a straight unmachined end of Transite pipe to be connected to a section of Transite pipe with a tapered end, the Duplex coupling shown in Fig. 5 may be used.

The one end of this coupling forms a sleeve coupling as described earlier in this article.

Split and Bolted Couplings

Split and bolted couplings, Fig. 6, are used to join Transite pipe sizes 16 to 36 in. when high flexural strength is required in the completed assembly for

locations where the assembly must act as a continuous beam.

The coupling consists of a split and drilled Transite sleeve bolted to the ends of the pipe, and the pipe ends

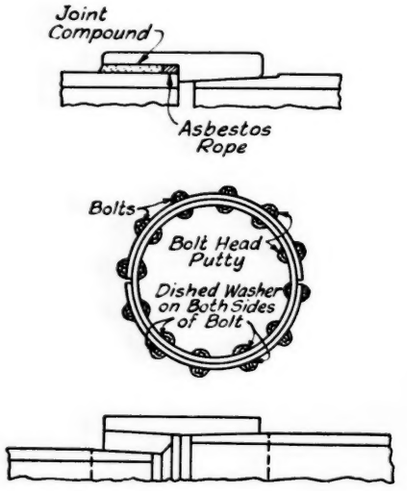


Fig. 5, upper. Duplex coupling. Fig. 6, center. Split and bolted coupling. Fig. 7, bottom. Reducer coupling.

are machined to fit the sleeve; ⅝ in. diameter bolts with lead washers under bolt heads and nuts are used. The bolt holes are drilled ¾ in. diameter and the space between bolts and bolt holes and all voids between the pipe and coupling are filled with Ferro compounds. The heads of the bolts and nuts are covered with bolt head putty.

This type coupling may be used for all installations where internal air pressure, positive or negative, does not exceed 16 in. of water. It cannot, however, be used with fittings as it requires a machined surface.

Reducer Couplings

The reducer coupling, Fig. 7, may be used with tapered end pipe in sizes 2 to 12 in. exclusive. One inch or two inch reductions on pipe diameters may be obtained by the use of this type coupling which provides for increased capacities to accommodate branch connections. This coupling may be used under the same conditions and has the same advantages as the taper couplings described previously.

JOINTS FOR OVERHEAD PRESSURE LINES

Transite pipe is also made in Class 50 to Class 200 from 2 to 36 in. diameter for use in exposed and buried pressure and non-pressure lines. It is commonly used in the pulp and paper industry for conveying fresh water, white water and stock, as well as in municipal and other industrial installations for both underground and overhead services.

For above ground installations the following types of joints are available.

Tee-Tite Couplings

The standard assembly Tee-Tite coupling for joining adjacent sections of Transite pipe is shown in Fig. 8. It consists of two split bushings *A* and *B* which are engaged by ring flanges *C*. Bolting the flanges together exerts pressure through the split bushings to compress a T-gasket *D* between the pipe ends, thus effecting a tight seal. This type of joint is satisfactory for pressures up to 50 lb per sq in. and for operating temperatures not in excess of 200F. When making this type joint the ends of the pipe must be machined and grooved for the split bushings as shown in Fig. 8*a*.

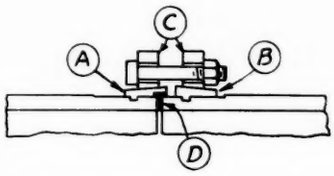
Where it is necessary to provide for deflection in the pipe line, the assembly shown in Fig. 9 may be employed, using a deflection ring of cast iron or other metals as required.

When a run of pipe connected with Tee-Tite couplings is rigidly fixed at both ends, provision should be made for expansion and contraction as described later.

Simplex Flange Couplings

This coupling, Fig. 10*a*, consists of two flange rings *A* which are forced over rubber rings *B* compressing them firmly to make a water-tight joint between the pipe and flange. The two flanges are then bolted together in the usual manner with a gasket between them.

Fig. 10*a* is the Simplex flange joint for use with adjacent sections of Transite pipe while Fig. 10*b* is the type used for connecting steel pipe with a screwed



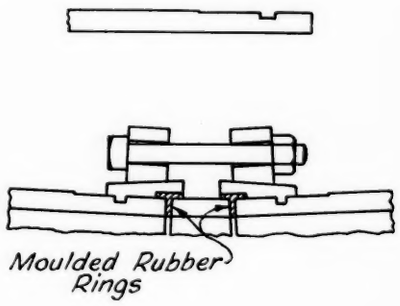


Fig. 8, upper. Standard assembly of Tee-Tite coupling. Fig. 8a, center. Detail of end of pipe for use with Tee-Tite coupling.

Fig. 9, bottom. Method of providing deflection with this type coupling.

flange to Transite pipe. A similar arrangement is shown in Fig. 10*c* for connecting Transite pipe to a cast iron tee. The end of the Transite pipe is machined as shown in Fig. 10*d* for this type of joint.

The same provision must be made for expansion and contraction as noted under Tee-Tite joints.

The method of applying and using a flange pusher is

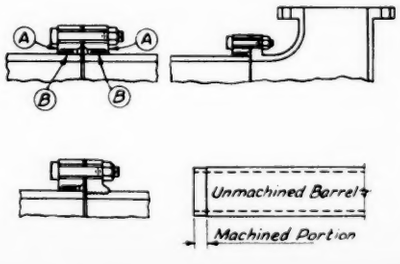


Fig. 10a, upper left. Simplex flange coupling. Fig. 10b, lower left. Type coupling used for connecting to steel pipe. Fig. 10c, upper right. Connection to a cast iron tee. Fig 10d, lower right. Method of machining pipe.

illustrated in Fig. 11. Operation of the jack handles pushes the flange over the rubber rings and into final position.

Poured Sleeve Couplings

The poured sleeve coupling, Fig. 12*a*, is furnished for use with all sizes and classes of Transite pipe and may also be used to join the same class of Transite pipe to standard AWWA spigot end pipe or fittings as shown in Fig. 12*b*. The ends of the pipe do not require machining but grooves are provided for anchoring the jointing compound. Self-calking sulfur base joint compounds are recommended for this type of joint. Before pouring, jointing tape is carefully applied to the ends of adjacent sections of pipe which are installed about ⅛ in. apart. Operating temperatures for this type joint should not exceed 200F.

Provision for expansion and contraction should be as described for Tee-Tite joints.

Ring and Follower Type Coupling

This type joint, Fig. 13*a* consists of a middle ring, with a gasket at each end and two follower rings which are pulled tightly together with bolts, compressing the gaskets against the middle ring and the pipes, making a tight joint.

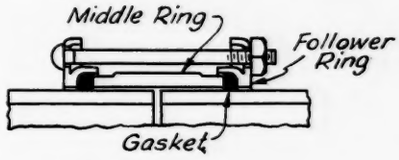
It is used for connecting adjacent sections of Transite pipe. The center ring is of Transite and the gaskets are rectangular in sections. The follower rings are of malleable iron and the ends of the pipe are not machined.

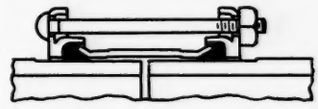
In Fig. 13*b* the ends of the pipe are machined and a steel middle ring with wedge shaped gaskets is used.

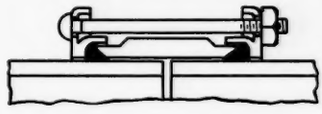
For coupling Transite to cast iron pipe, Fig. 13*a* may be used or a Transite middle ring with wedge gaskets as shown in Fig. 13*c* may be used.

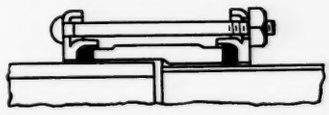
For connecting Transite pipe to steel pipe either of the joints shown in Fig. 13*d* with a Transite middle ring with rectangular gaskets, or as shown in Fig. 13*e* with a steel middle ring and wedge gaskets may be used.

In each case the ends of the pipes should be spaced about ⅛ in. apart to allow for expansion.









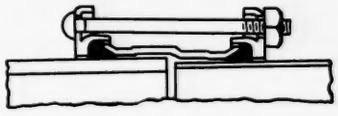


Fig. 13, from top to bottom—a, ring and follower type coupling; b, coupling for Transite to Transite; c, Transite pipe to cast iron pipe, with wedge gaskets; d, Transite to steel pipe with rectangular gaskets; e, coupling with steel middle ring for Transite pipe to steel pipe.

The maximum temperature for which this type of joint should be used is 200F.

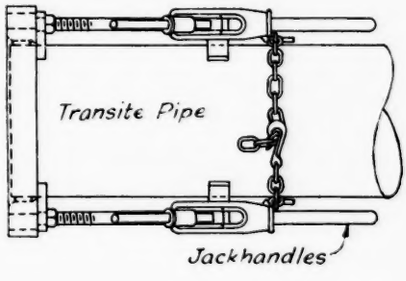
Simplex Couplings

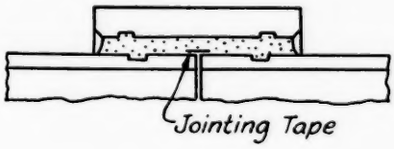
The Simplex coupling, Fig. 14*a*, consists of an asbestos cement sleeve *A*, identical in composition to Transite pressure pipe which is forced over two rubber rings *B*, effecting a tight joint by compressing the rings between the sleeve and pipe. It shows a coupling for two sections of Transite pipe. The ends of the pipe are spaced about ¼ in. apart to allow for expansion. One pipe end *C*, must be machined a distance equal to twice the coupling length plus 1 in. as shown in Fig. 14*b*, starting position.

The coupling should be slid over the pipe end *C* with the higher shoulder (back end) first. The two rubber rings should then be applied and pushed back to their proper location. The first should be pushed back one coupling length. The second rubber ring should then be applied to the same pipe end *C*, but it should be pushed back only about ½ in. as shown in Fig. 14*b*. A wood gage, 14*c*, may be used to establish a stop mark on the second pipe end *D*. The sleeve should then be pulled with a sleeve puller to the stop mark. The rings will roll into the correct position for properly sealing the joint. The pipe surface of end *D* must be machined for not less than one plus one-half coupling lengths.

Fig. 14*d* shows a self-locking Simplex adapter for connecting steel to Transite pipe, sizes 2 to 8 in. The adapter consists of a Transite sleeve and three rubber rings. It operates on the same principle as the regular Simplex coupling. The adapter must be pulled, using

Fig. 11. Method of applying and using a large pipe pusher.





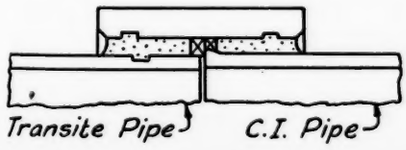


Fig. 12a, upper. Poured sleeve coupling. Fig. 12b, lower. Poured sleeve joint for Transite to AWWA pipe.

standard pulling equipment from the steel pipe onto the Transite pipe.

Proper location of the rubber rings prior to assembly

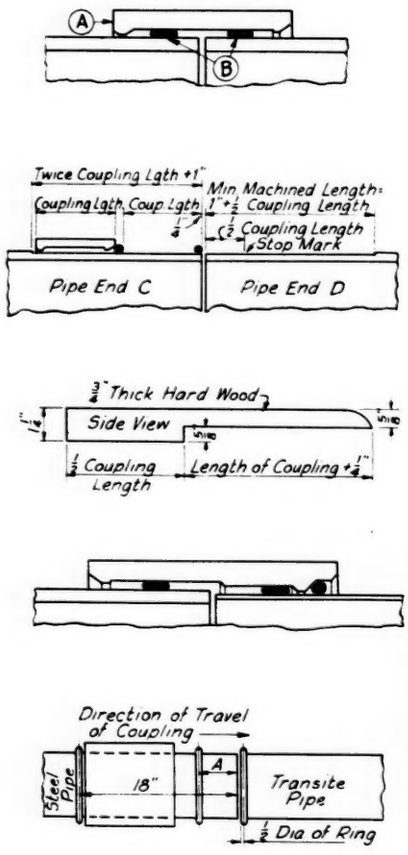


Fig. 14, top to bottom — a, simplex coupling; b, location of rubber rings; c, wood gage for pushing rings along pipe; d, Transite to steel pipe with self-locking Simplex adapter; e, location of coupling and rings prior to assembly.

as shown in Fig. 14*e* is important. The following sequence of steps will simplify assembly:

(1) Place one rubber ring on the steel pipe 18 in. from the end.

(2) Set the adapter on the steel pipe with open lip facing direction of assembly.

(3) Place center ring on steel pipe distance *A* as given on Fig. 14*e*.

(4) Set third ring on the Transite pipe as close as practicable to the end.

(5) Pull the adapter forward onto the Transite pipe 4 to 4½ in.

(6) Roll the locking ring tight against the back shoulder as shown in Fig. 14*d*.

Before assembling Transite Simplex coupling joints a careful check should be made to insure that lateral displacement between abutting pipe does not exceed ⅛ in, nor should the maximum space between pipe ends exceed ¼ in. Any displacement or opening greater than these amounts may cause the rubber ring to be misplaced or dropped between the ends of the pipe during assembly.

The maximum recommended operating temperature for Transite pipe when joined with Transite Simplex couplings is 150F.

Transite Simplex Expansion Joints

Where expansion joints are required, the Transite Simplex expansion joint should be used.

For this joint, ends of the pipe must first be machined for the proper distance as recommended by the manufacturer. The Transite sleeve should then be assembled on a section of pipe before installing it in place. This is done by placing the pipe section *A*, Fig. 15*a*, on temporary wood blocks on the floor. The expansion coupling is slid over the end of the pipe with the beveled end of the coupling facing as shown. One rubber ring is snapped onto the pipe and set at a point 7½ in. from the end. For assembly purposes only, pipe section *B*, Fig. 15*b*, is also lined up on temporary wood blocks and butted against length *A* as shown. A stop mark is made on this length 5½ in. from the end. The pipe section *B* may be shorter than standard and need not have a machined end as it is used as a temporary tool to be removed and used again for each assembly.

A coupling puller is fastened to length *B* and the coupling pulled forward to the stop mark as noted. On completion of this step in the assembly the coupling puller and pipe section *B* are removed.

The coupling should then be secured rigidly to pipe length *A* by pouring a sulfur-base self-calking joint compound into the bell at left of the rubber ring, Fig. 15*c*. The rubber ring eliminates the necessity for yarning the joint.

The assembly is completed after the pipe section with attached expansion joint is installed in the pipe line. A second rubber ring is placed close to the end of section *C* as shown, Fig. 15*d*. This section *C* will be used in the pipe line and must have a machined end.

A stop mark 4 in. from the end, is made on the pipe as illustrated. Note that the location of this stop mark is not the same as the stop mark on pipe lengh *B*.

Length *C* is lined up and moved toward the coupling until the rubber ring enters the bevel evenly around the coupling. The coupling puller is fastened to length *C* and the pulling collar or hooks placed around the coupling. The pipe is then pulled into the

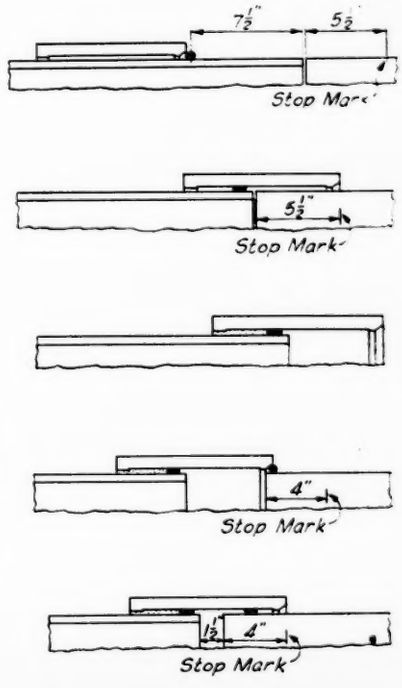


Fig. 15, top to bottom—a and b, assembling Transite Simplex expansion joint by lining up pipe lengths; c, calking compound applied to joint; d, applying the second rubber ring; e, completion of installation.

coupling, Fig. 15*e*, until the stop mark is reached. This automatically establishes a normal clearance of 1½ in. between pipe ends and allows for expansion and contraction.

JOINTS FOR UNDERGROUND LINES

Where local regulations do not prohibit its installation, Transite pipe with Taper-Tite couplings provides material for a house sewer which is quickly and easily installed. A typical joint, Fig. 16, consists of a Transite coupling with a tapered factory-applied asphalt lining into which the tapered ends of Transite house connection pipe which have been asphalt primed at the factory, are inserted.

Before assembling, the ends of the pipe and the inside of the coupling should be wiped clean with a dry cloth and then a primer supplied by the manufacturer should be applied with a brush to the inside of the coupling and the outside end of the pipe. The coupling should then be pushed over the end of one section of pipe with a twisting motion, then a board should be placed over the end of the coupling and tapped with a hammer until the coupling is firmly in position. The end of the next section of pipe should then be wiped clean, primer applied, and the same procedure followed.

This type joint is quickly and easily assembled on the job, as no hot jointing materials are required and, when properly installed, it stubbornly resists root growth and infiltration of ground water into the sewer. The joint is flexible which reduces beam stresses in the lines.

Transite sewer pipe is made in four weights: Class 1 for normal service sizes 4 to 36 in.; Class 2 for service demanding extra strong pipe with inside diameters from 10 to 36 in.; and Classes 3 and 4 when exceptional strength is required, with inside diameters 10 to 36 in. and 18 to 36 in., respectively.

The joint shown in Fig. 17 is furnished for this type service. The ends of the pipe and the inside of the coupling should be washed or wiped clean and thoroughly dried before assembly and any scratched surfaces should be touched up with sewer pipe primer. The pipe should first be assembled in the trench with

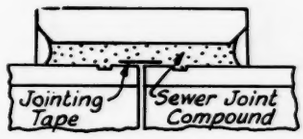
Fig. 16. Transite pipe with Taper-Tite coupling for house sewers.

the ends of the two sections of pipe squarely butted together and the coupling over the end of one pipe. After the section of pipe to be installed is properly lined up and graded, it should be pulled forward so that the ends of the two pipes will be separated ⅛ in. to allow for expansion.

Jointing tape should be applied over the ends of the pipe, the sleeve coupling centered over the joint, and the sewer joint compound heated to a temperature of 450F and poured in the usual manner.

For underground water mains, Simplex couplings as described for overhead pressure lines should be used. Thrust blocks of concrete should be provided at fire hydrants, at the back of tees for lateral branches, and at changes in direction of the mains to prevent breakage of couplings or fittings.

Fig. 17. Transite sewer pipe and sleeve coupling.



Selection of Type of Joint to be Used

The type of joint to be used for vents, ducts, stacks or other similar low pressure piping systems not used for conveying liquids will probably be determined by the following considerations: First cost; ease of assembly; requirements for expansion and contraction due to temperature changes; the degree of rigidity required on the assembled pipe line; pressure to be maintained in the system.

The use of sleeve and heavy sleeve couplings eliminates the necessity for costly machining of pipe ends and permits the more ready use of pipe which must be cut to measure in the field.

This type joint, especially when supplied with heavy sleeve couplings, is rigid and if the joint is carefully made, should prove tight for low pressure service. There is no provision for expansion however and care must be used when making the joint to insure that the edges of adjacent sections of pipe are butted squarely together; the pipe is properly aligned; packing rings and the sleeve properly located with relation to the ends of the pipe and the jointing compound carefully and correctly applied in accordance with the instructions furnished by the manufacturer.

Ribbed couplings are somewhat higher in first cost but greatly simplify the locating of packing rings and sleeve on the pipe.

Tapered couplings require careful machining of the ends of the pipe as well as the inside of the coupling; make no provision for expansion and contraction of the pipe and provide a minimum of rigidity. With reasonable care joints can be assembled quickly with unskilled help and made tight, without danger of splitting the coupling or crushing the tapered end of the pipe.

The Simplex coupling requires accurate machining of the ends of the pipe, care in locating the rubber rings and the spacing of the pipe. The proper spacing of the pipe provides for expansion and contraction, and higher pressures can be maintained with this type of joint.

The split and bolted coupling provides rigidity and if carefully made should be tight against moderate pressures but makes no provision for expansion and contraction and requires considerable care in assembly.

When selecting the type of joints to be used for overhead water lines or other lines conveying liquids under pressure, consideration must also be given to the stresses developed in the pipe and joint due to: Internal pressure; weight of liquid and pipe; longitudinal thrust due to temperature changes; gasket grip; expansion of the pipe due to moisture absorption; bolt tension; buckling; and lateral thrust.

Ordinary steel pipe is considered to be capable of

standing tensile, longitudinal (modulus of rupture) and compressive stresses of 55,000 lb per sq in. but when designing pipe lines for industrial systems, it is customary to limit total combined stresses from all causes to 16,000 lb per sq in. which corresponds to a factor of safety of 3.5.

If the same factor of safety were to be used for Transite as for steel pipe, it would be necessary to limit the total combined tensile and longitudinal stress from all sources including bending and bolt tension to approximately 500 lb per sq in. and to limit the total compression stress to approximately 2,000 lb per sq in.

No attempt will be made to show how the stresses listed can be computed but the relationship between the types of joints shown and stresses that may be developed will be considered.

Stress due to internal pressure is not affected by the type of joint used.

Stress due to weight of the liquid and pipe will depend on whether the pipe ends are rigidly gripped at the joints and whether there is any restraint at the ends due to improper centering of the pipe in the couplings. If pipe ends are relatively free, the stress may be determined by assuming each section of pipe as a separate beam hinged at the points of support. If the pipe ends are restrained, the stress may be determind by assuming the pipe line is a continuous beam. Joints using Simplex coupling as shown in Fig. 14*a* will most nearly approximate the first condition and joints using the poured sleeve coupling as shown in Fig. 12 may be considered to act as a continuous beam.

Stress due to longitudinal thrust because of temperature changes will depend on the grip between the ends of the pipe and the gasket or jointing compound. Poured sleeve couplings do not make any provision for movement of the pipe due to temperature change and therefore (except when used on buried lines where there is very little change in temperature either of the fluid inside the pipe, or the ground) it is necessary to provide expansion joints at intervals in the pipe line.

Joints using Tee-Tite couplings also do not provide for any movement of the pipe due to temperature change; expansion joints should be provided as the ends of the pipe are restrained.

Joints using ring and follower type couplings should be set up with the minimum bolt tension that will insure a tight joint as the grip of the gasket is increased by tightening the bolts, thus increasing the stress due to longitudinal thrust. Bolts are usually set up when the pipe line is cold and as the temperature in the line increases due to hot liquid flowing through it, the pipe which is in direct contact with the heated liquid will expand more rapidly than the coupling, which will further increase the grip of the gasket.

Stress due to longitudinal thrust for joints using Simplex couplings or Simplex flanged couplings is governed by the shape, size and material of the gasket but the comments on the effect of temperature changes for ring and follower type couplings apply.

The stress due to gasket grip tends to crush the reduced section of the pipe ends. Increasing the tension on the bolts in ring and follower type couplings increases the pressure of the gasket on the pipe and the coupling, and if bolts are tightened excessively, may cause failure of the pipe.

Transite pipe absorbs moisture and expands appreciably because of this. This increases the stress due to gasket grip and the stress due to longitudinal thrust. Each of the type of joints discussed is probably equally affected by this condition. Impregnation of the pipe to prevent moisture absorption would be helpful but in most cases is probably too costly. Saturation of the pipe before erection might be helpful where ring and follower type joints are used.

When a long straight pipe which is anchored at both ends expands, the joints must slip or yield or the line must buckle. If the line buckles sufficiently to cause the pipe to rest against the sides of the coupling, any further buckling will tend to pry the halves of the coupling apart and as the leverage is considerable in a 10 ft length of pipe, any slight additional buckling may break the coupling. With the Simplex coupling considerable lateral displacement of the pipe is necessary before contact between the outside circumference of the pipe and the inside of the coupling will occur if the pipe is accurately centered in the coupling. With ring and follower type couplings using Transite middle rings, the clearance is much less and this type of joint is therefore probably more susceptible to breakage from this cause. The shape of the steel middle ring shown in Fig. 13*a* tends to reduce the possibility of breakage due to buckling.

Branch connections to a main may, unless properly anchored at the junction point, cause buckling of the main because of lateral thrust due to expansion.

It is therefore apparent that proper anchorage of pipe lines and care in the selection of the correct type of joint to prevent excessive stresses at the joints is essential where Transite piping is to be used, and where possible a careful analysis of the stresses likely to occur should be made by the manufacturers, engineers, or an independent engineer experienced in this class of work before installation of any such piping system of appreciable size.

Poured joints using self-calking sulfur-base joint compounds with Transite pipe and Transite couplings have not been as commonly used as some of the other types of joints and even with pressures as low as 10 lb per sq in. they have not always been tight.

While the manufacturers of a well known joint compound of this nature deny that corrosion or rust play any part in making a tight joint with their compounds, it has been found that when used with noncorrosive water in cast iron pipe, the joints have not been tight.

Erectors of piping systems using this type of joint compound prefer a rough surface for its application. The surface of Transite pipe will commonly be as rough or rougher than that of cast iron pipe and it would therefore appear that lack of corrosion may account for failure to make a tight bond between the compound and the pipe or pipe coupling.

Use of Simplex couplings under conditions where the rubber gaskets may be subject to the effects of oil, as in oil soaked grounds of refineries, etc., is not desirable and the manufacturers of Transite pipe advise against it.

Water Treatment for HEATING and AIR CONDITIONING

WILLIAM H. LANG

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HEATING AND VENTILATING
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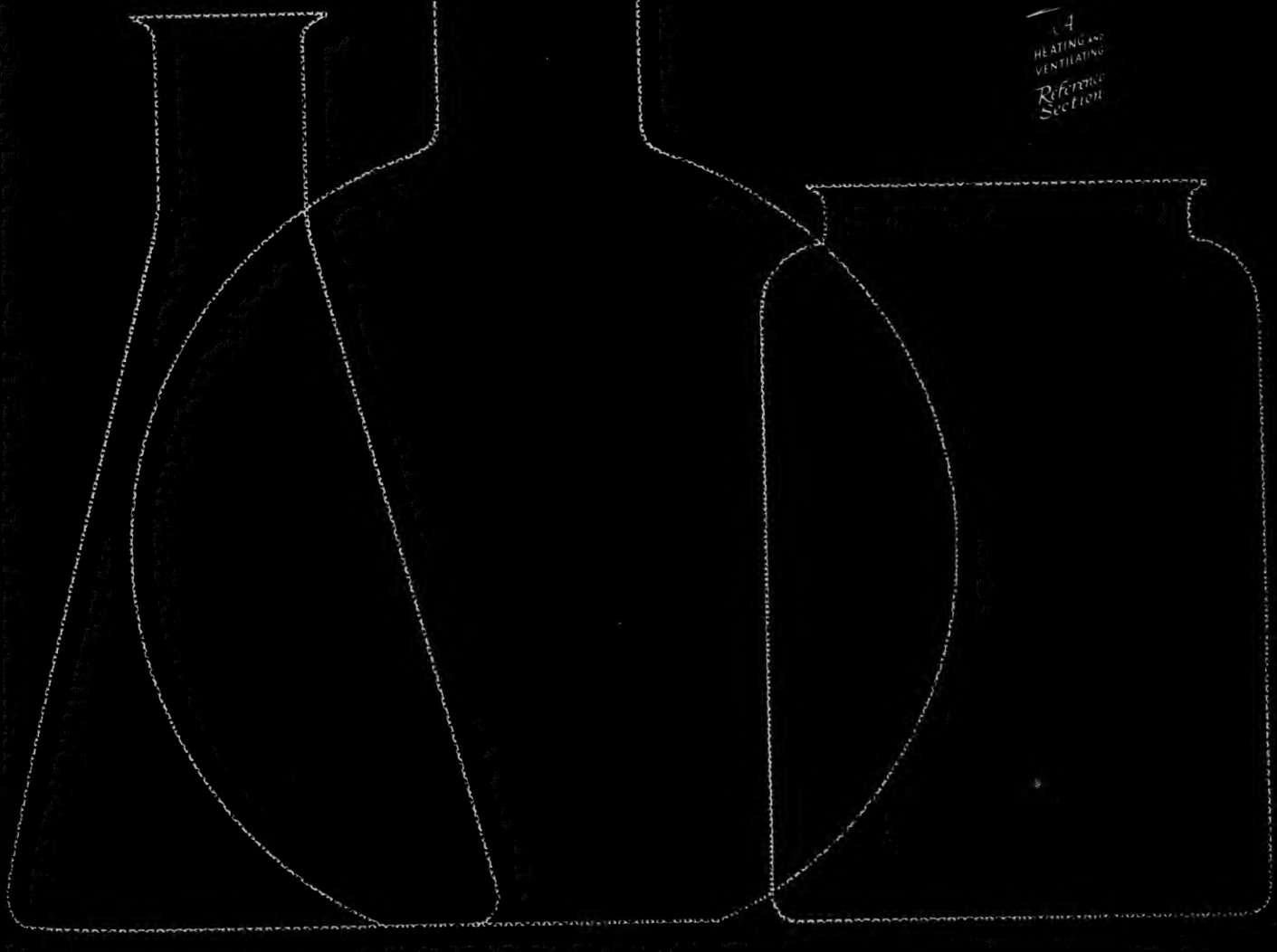


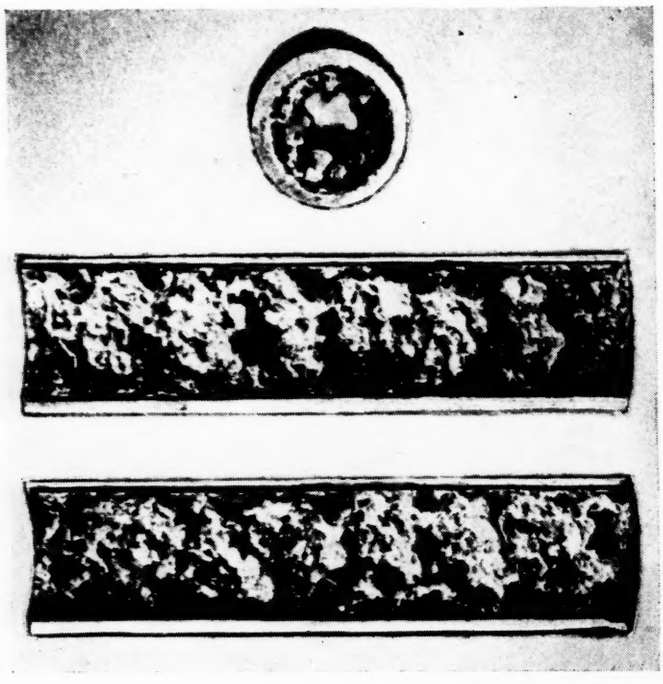
Water Treatment For Heating and Air Conditioning

WILLIAM H. LANG*

Water treatment is so important to the engineer concerned with heating and air conditioning, that some understanding of such treatment is necessary to obtain good operating conditions and to alleviate or eliminate troubles resulting from unsuitable water characteristics. Data are presented on the difficulties resulting from common impurities in water, and the recommended treatments for correcting conditions.

WATER, our most abundant natural resource, is never found pure in nature. The nearest approach to chemically pure water is rain water, yet it contains small amounts of organic matter and dissolved gases which it picks up from the air as it falls to the earth's surface. After reaching the earth, it either percolates into the soil ultimately becoming ground water or it drains from the earth's surface into various streams and other bodies becoming surface water.

As a result of its contact with the earth, certain substances contained within the soil are dissolved and thereafter are carried in solution while other materials, yet insoluble, are picked up and carried in suspension. It is a general rule that ground water will contain more dissolved substances than surface water, little if any suspended materials and usually no pathogenic bacteria; surface waters generally contain less dissolved substances, an abundance of suspended materials and usually are considered as being bacteriologically polluted.



Courtesy, Calgon, Inc.

Section through ferrous pipe to show the effect of untreated, soft, corrosive water. Pipe was almost blocked with rust formation.

The dissolved substances generally found in water are the bicarbonates, sulfates, chlorides and nitrates of calcium, magnesium and sodium, iron and manganese compounds, silica and alumina, and gases such as carbon dioxide, oxygen and sometimes hydrogen sulfide. Suspended matter usually includes mud and sand, organic matter and microscopic organisms such as bacteria and algal forms. A complete list of the substances found in water is given in Table 1. This table also includes the difficulties caused by these materials and the common methods for their removal.

Treatment for Industry

As a result of these impurities, it becomes necessary to purify water before it can be used. Purification is carried out in order to make water suitable for the use to which it will be put—domestic water supply, including drinking water, and industrial water supply. It is the latter in which our present interest lies.

The use in industry to which the water will be put indicates to some extent the degree of water treatment. In industrial water supply conditioning, it is not generally possible to subject a water to a method of treatment and expect to be able to use that water successfully in a number of different processes. Process water used in paper making, rayon manufacture and other textile industries must possess a high degree of purity and have zero color in order to produce a quality product. In the beverage industry, process water must be free from turbidity and its taste and odor controlled so that these characteristics are not imparted to the product. And when water is intended for use as boiler feed or in air conditioning, still other types of treatment are necessary.

Not only is the method of water treatment indicated by its proposed use, but also by the character of the water itself. An important characteristic is the pH value, which is 7.0 for a neutral water. Values from 7.0 to 14.0 indicate an alkaline water with the number increasing as the alkalinity increases. Values of pH from 0. to 7.0 show an acid water. The degree of acidity increases as the number decreases.

If a water contains enough suspended material to interfere with the process for which the water is intended, the turbidity will have to be removed by sedimentation alone or in conjunction with coagulation by

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Chemical Abbreviations and Formulas

$(C_6H_{10}O_5)$ X = Starch
$CaCO_3$ = Calcium carbonate
$Ca(HCO_3)_2$ = Calcium bicarbonate
CaO_2 = Calcium peroxide ($CaO_2 \cdot 8H_2O$)
$Ca(OH)_2$ = Calcium hydroxide or hydrated lime
$CaHPO_4$ = Calcium acid phosphate
$Ca_3(PO_4)_2$ = tricalcium phosphate
CaZ = Calcium zeolite
Cl_2 = Chlorine
CO_2 = Carbon dioxide
Fe = Iron
$FeCO_3$ = ferrous carbonate
$Fe(HCO_3)_2$ = ferrous bicarbonate
$Fe(OH)_2$ ferrous hydroxide
H_2 = Hydrogen
HCl = Hydrochloric acid
H_2CO_3 = Carbonic acid
H_2O = Water
HOCl = Hypochlorous acid
H_3PO_4 = Ortho phosphoric acid
H_2S = Hydrogen sulfide
H_2SO_4 = Sulfuric acid
H_2Z = Hydrogen zeolite
$MgCl_2$ = Magnesium chloride
$MgCO_3$ = Magnesium carbonate
$Mg(HCO_3)_2$ = Magnesium bicarbonate or magnesite
$MgSO_4$ = Magnesium sulfate or epsom salts
Mg Z = Magnesium zeolite
$Na_2Al_2O_4$ = Sodium aluminate
NaCl = Sodium chloride or table salt
Na_2CO_3 = Sodium carbonate or soda ash
Na_2HPO_4 = Anhydrous sodium phosphate
$Na_2H_2PO_4$ = Monobasic sodium phosphate
NaOH = Sodium hydroxide or caustic soda
$Na_2O \cdot Al_2O_3 \cdot SiO_2$ = Zeolite
NH_2Cl = Monochloramine
$NHCl_2$ = Dichloramine
NCl_3 = Trichloramine
Na_3PO_4 = Sodium phosphate
$NaPO_3$ = Sodium metaphosphate
Na_2SO_4 = Sodium sulfate
Na_2SiO_3 = Sodium silicate or water glass
Na_2Z = Sodium zeolite
O_2 = Oxygen
SiO_2 = Silicon dioxide or silicic acid anhydride
RCO_3 = } Anion exchange material.
$R(OH)_2$ = } R represents the complex anion exchange body similarly as Z represents the complex zeolite radical.

chemical agents. If a water is highly colored due to dissolved materials, the color will have to be removed by chemical precipitation methods. If objectionable substances such as iron and manganese are present, they must be removed before the water is suitable for use in some processes. When water is to be used for boiler feed, the scale-forming substances must be removed by softening, and the corrosive nature of the supply altered so that metal surfaces will not be attacked.

In other words, the character of the water will have to be changed to such an extent that it will be suitable for its intended use and will not be harmful to the surfaces of the equipment with which it comes in contact in that process. In this respect, heating and ventilating engineers are interested in water to the extent of its scale forming, priming, foaming and embrittlement tendencies and its corrosivity.

SCALE FORMATION AND WATER HARDNESS

Scale formation in boilers is caused by dissolved substances in the feedwater, generally referred to as hardness constituents. These substances, in addition to their ability to deposit as boiler scales, interfere with many industrial processes such as canning and paper making.

Water hardness is caused principally by the bicarbonates and sulfates of calcium and magnesium. The bicarbonates of these metals are referred to as temporary hardness factors while the sulfates and salts, other than the bicarbonates, are the permanent hardness factors. Temporary hardness is characterized by the fact that its contributors tend to precipitate from solution quite readily when water is heated; permanent hardness factors remain in solution. However, since magnesium carbonate and some others are only partially precipitated by heating, the terms temporary and permanent hardness have been discarded for the more definite terms carbonate and non-carbonate hardness.

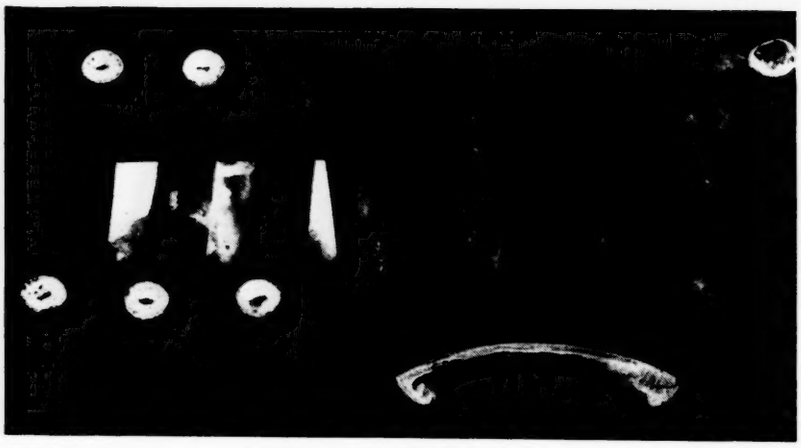
Carbonate hardness, however, is not caused by carbonates but by calcium and magnesium bicarbonates, which break down from their heated solution to deposit as the carbonate with the liberation of carbon dioxide according to the following:

$$Ca(HCO_3)_2 + \text{heat} = CaCO_3 + CO_2 + H_2O$$

The composition of the water determines the type of scale formation. Carbonate scales are generally soft and porous while sulfate and silicate scales are dense.

Courtesy, W. H. & L. D. Betz

Loose scale formations that became cemented together.



Courtesy, Calgon, Inc.

Hot water heating coil which failed due to scale which formed during six months service with untreated hard water.

The mechanics of scale formation have been explained by several investigators, the most satisfactory of which is that of Partridge (2) who states that deposition may take place in three ways.

(1) Settling out of suspended particles in water followed by cementation on boiler surfaces.

(2) A salt of a supersaturated boiler water spontaneously crystallized at the heating surfaces of the boiler. At this point, supersaturation exists to a greater degree as the solubility of scale constituents is decreased by the elevated temperature in the fluid film contacting the heating surface.

(3) Bubble evolution at an evaporation surface in which scale will be deposited in a circle due to the line of bubble contact with the dry surface beneath it and the solution around it.

Briefly, the prevention of scale formation can be accomplished by using distilled make-up water, external treatment in which make-up water is conditioned before entering the boiler, and internal treatment in which unconditioned water is fed to the boiler along with chemicals which will react in the boiler with harmful substances dissolved in the water.

Inasmuch as no method of internal chemical treatment generally operates at a temperature as high as that of the boiler water, it follows that when the treated feedwater is elevated to the boiler operating temperature, the solubility of the scale forming salts is exceeded and they crystallize as scale on the boiler heating surfaces.

One theory advanced in explanation of the mechanism of scale formation states that a salt is precipitated from solution in which state it settles on the boiler heating surfaces where it bakes in place as scale. It has been stated that scale formation in this manner has occurred particularly in fire tube boilers and where the boiler feed water is high in hardness content. Generally speaking, only a minor portion of scale develops in this manner.

The theory of scale formation of most universal adherence is that of crystallization of scale-forming salts from a solution which becomes locally superheated. In this process, the thin film of water immediately adjacent to the boiler heating surface becomes more concentrated than the main body of boiler water due to the local superheating. As a result, the solubility of the scale-forming salts is exceeded in the thin water film resulting in a direct crystallization of scale on the heating surface, although in the main body of boiler water, the solubility of scale-forming salts has not been exceeded.

The common insulating effect of boiler scale is well known. The layer acts as a barrier against heat transfer with a resultant decreased efficiency of the boiler and a lower production of steam per unit of fuel. It then follows that when boiler scale is present, more heat has to be supplied to produce the required amount of steam. Overheating and consequent tube failure may result.

Scale formation depends upon the quality of the feedwater and the amount of dissolved salts it contains. Dissolved salts are instrumental in causing scale, as well as suspended matter such as mud and silt commonly present in surface waters. Suspended materials are easily removed from water by sedimentation, either with or without the use of chemical coagulating agents, and generally followed by filtration.

It is obvious that if mud and silt are not removed from a feedwater supply, they will settle out under decreased flow conditions, and may deposit within the boiler at points of low flow. When this occurs, the deposit formed may become baked in place and produce results similar to true boiler scales. Mud and silt also interfere with heat transfer in heat exchangers. Such materials generally contain enough organic material and organisms to form slime deposits on surfaces within these units. Control of slime deposits will be discussed later.

In the general thinking regarding scale formation, first thoughts, and rightly so, are directed toward a consideration of the calcium and magnesium content of the feedwater. These constituents, the most influential in scale formation, are removed in the various external treatments which may be applied to the feed water. However, some residual hardness usually may remain. It then becomes necessary to apply an internal treatment to control all scale-forming materials. Chemicals most commonly used for internal water treatment, including the advantages and disadvantages of each, are listed in Table 2 (1).

Compounds of calcium which may be found in boiler scales are carbonates, sulfates, phosphates and silicates. Carbonate scale usually results from the break-

Table 1 — Common Impurities Found in Water

Name	Chemical Formula	Class of Solids	Difficulty Caused by Its Presence	Unit Process or Common Means of Removal	Special Remarks
Acids, sulfuric hydrochloric	H_2SO_4 HCl	Dissolved Dissolved	Causes corrosion. In excessive quantities, harmful to human consumption	Neutralization with alkalies	Presence is usually due to contamination by trade wastes
Algae		Suspended, colloidal and dissolved	Clogs spray ponds and condensers. Imparts odor, taste and color to water	Chlorination or other chemical treatment such as sodium pentachlorphenate or copper sulfate	Algae are plant growths of many different families, some more difficult to destroy than others
Bacteria		Suspended, colloidal and dissolved	Source of disease. Renders water unfit for human consumption	Ultra violet light, chlorination, coagulation, filtration	Many forms of bacteria are present in water, most of which are harmful to the human system
Calcium					
1. Calcium Bicarbonate	$Ca(HCO_3)_2$	Dissolved	Imparts hardness.	1. Heating and softening	The calcium salts are the chief causes of scale formation in boilers
2. Calcium Carbonate	$CaCO_3$	Dissolved	Causes scale in boilers.	2-3. Softening. Internal chemical treatment in boilers	
3. Calcium Sulfate	$CaSO_4$	Dissolved	Produces insoluble curds in washing processes		
Carbon Dioxide	CO_2	Dissolved gas	Causes acid corrosion and decreases pH of water	Aeration, neutralization with alkalies	
Hydrogen Sulfide	H_2S	Dissolved gas	Imparts odor and taste. May impart color. Interferes with process work	Aeration, chlorination and filtration	Found principally in ground waters and polluted surface streams
Iron (Ferrous bicarbonate)	$Fe(HCO_3)_2$	Dissolved	Causes discoloration of water. Imparts taste. Causes deposits in boilers. Harmful for many industrial uses	Aeration and filtration; chlorination and filtration. Some base exchange softening processes as lime soda softening; pH adjustment; filtration	Manganese and aluminum are also frequently found in many waters in very minute amounts and are mostly removed by any iron removal treatment
Magnesium					
1. Magnesium Bicarbonate	$Mg(HCO_3)_2$	Dissolved	Imparts hardness.	1. Heating and softening	Next to calcium salts, magnesium salts are the chief causes of scale formation in boilers. Magnesium scale is not quite so hard as a calcium scale
2. Magnesium Carbonate	$MgCO_3$	Dissolved	Causes scale in boilers.	2-3-4. Softening. Internal chemical treatment in boilers	
3. Magnesium Sulfate	$MgSO_4$	Dissolved	Causes insoluble curds in washing processes.		
4. Magnesium Chloride	$MgCl_2$	Dissolved	$MgCl_2$ is also corrosive		
Mud, clay, silt		Suspended or colloidal	Impart taste. Harmful in process work. Scale, sludge and carry-over in boilers	Subsidence, coagulation, filtration	
Odors		Dissolved gases	Impart odors and render water unpalatable	Aeration, filtration, activated carbon	
Oil		Suspended or emulsified	Harmful to boiler operation. Cannot be tolerated in many industrial processes	Coagulation and filtration. Filtration through cloth-grease extractors	Usually due to contamination by trade wastes or oil-bearing condensate. Frequently very troublesome
Oxygen	O_2 (Expressed as O in determinations)	Dissolved gas	Causes corrosion and pitting (a specific form of corrosion) in boilers	Mechanical deaeration; chemical treatment with sodium sulfite	Can also cause pitting and corrosion in steam lines, turbines, economizers, etc.

Table 1 – Common Impurities Found in Water – (Continued)

Name	Chemical Formula	Class of Solids	Difficulty Caused by Its Presence	Unit Process or Common Means of Removal	Special Remarks
Sewage		Suspended and dissolved	Renders water unfit for human consumption. May cause corrosion and carry-over in boilers. Harmful in process work	Many specialized mechanical and chemical treatments	Proper place for correction of sewage is prior to its discharge into streams
Silica (Sodium silicate)	SiO_2 Na_2SiO_3	Suspended Colloidal Dissolved	Causes extremely hard scale in boilers	Suspended silica-coagulation and filtration. Dissolved silica, external chemical removal in the hot by means of magnesium oxide; in the cold by ferric salts	Silica, particularly when combined with aluminum salts, forms an extremely hard scale in boiler
Sodium bicarbonate	$NaHCO_3$	Dissolved	All sodium salts listed, except NaCl, impart alkalinity to boiler water, cause foaming in boilers and require excessive blowdown	Distillation. Cation-anion exchange	Sodium salts are found in practically all water supplies. All are very soluble and cannot be removed by chemical precipitation
Sodium carbonate	Na_2CO_3	Dissolved			
Sodium hydroxide	NaOH	Dissolved			
Sodium chloride	NaCl	Dissolved			

From Betz Handbook of Industrial Water Conditioning, W. H. and L. D. Betz, Philadelphia, Pa.

down of calcium bicarbonate in the presence of heat. As most methods of internal treatment remove calcium in a form other than its sulfate, the presence of calcium sulfate in a scale usually denotes inadequate internal treatment. Calcium silicate may result from the combination of those elements present in the feed water or from improperly controlled treatment of the water by silicate compounds. Likewise, the presence of calcium phosphate usually is dependent upon the use of phosphate compounds in feedwater treatment.

Although magnesium salts may in general be more easily removed from water than calcium compounds, magnesium salts such as hydroxides, silicates and phosphates have been found in boiler scales. Magnesium is generally removed from the feedwater in the form of the hydroxide. Not only can silica unite with magnesium and calcium to form scale but also with aluminum to form complex scales.

The presence of oil in the feedwater is to be avoided as it increases the tendency of other materials to form scale or it may in itself become altered in character to form carbonized or coke-like scale.

Scale Control

Water treatment to control scale may be either external, internal, or a combination of both. External treatment is that which takes place outside the boiler, while internal treatment is carried out within the boiler. External treatment has for its main accomplishment the removal of constituents from the water which will be conducive to scale formation, while internal treatment is carried out to maintain the objectionable constituents of the water in a form in which they will not take part in scale formation.

Inasmuch as the material being treated is water and is a greatly variable material in nature, it follows that no one treatment will be satisfactory for all waters. It then becomes necessary to know the nature of the water which is proposed for use or its use before a method of treatment is established. Too many times, compounds are used internally as a material stated to be capable of rendering the water safe for use. Since the boiler installation is a costly item, the water or the raw material to be used in it certainly deserves primary consideration.

Carryover

Boiler feedwater can also cause carryover, priming and foaming in boilers. These terms are mentioned simultaneously as they are commonly used synonymously, but they all are quite different.

Carryover denotes a continuous entrainment of a small amount of solids from the boiler water with the steam, whereas when foaming occurs, bubbles are produced on the surface of the boiler water by which boiler water is entrained in the steam. The foam produced may fill the entire space of the steam boiler or it may only cover the surface of the boiler water.

Priming is a term applied to the familiar bumping which takes place when water is heated. The phenomenon is caused by localized superheating of the boiler water resulting in a violent intermittent action in which slugs of water are thrown over with the steam.

When these conditions occur, the solids entrained in the steam cause deposits to form within the system beyond the steam chest which results in loss of turbine efficiency and other difficulties. False boiler water levels may also be indicated.

Table 2 — Internal Treatment Chemicals for Scale Prevention

Name	Formula	Use	Advantage	Disadvantage
Reactive Colloids	High molecular weight organic complexes. Sodium mannuronate	To provide fluid sludge and to minimize carryover	Actual reaction with calcium and magnesium. Marked adsorption effect on crystalline precipitates.	No direct control
Sodium Aluminate	$Na_2Al_2O_4$	Precipitates calcium and magnesium	None	High alkalinity; analcite type scales
Sodium Carbonate (Soda Ash)	Na_2CO_3	To establish alkalinity; to precipitate hardness	Low cost. See Tannin. It is more easily handled than caustic soda	$CaCO_3$ forms scale. Na_2CO_3 breaks down releasing CO_2 with steam. Develops alkalinity. Must be controlled similar to caustic
Sodium Hydroxide (Caustic Soda)	NaOH	To establish alkalinity; to precipitate magnesium	Contains no carbonate, therefore does not favor formation of $CaCO_3$ scale	Removes only magnesium hardness. Alkalinity must be carefully controlled.
Sodium Phosphates	NaH_2PO_4 Na_2HPO_4 Na_3PO_4 $NaPO_3$	To precipitate calcium	Calcium phosphate, $Ca_3(PO_4)_2$, is least adherent of crystalline precipitates	Finely divided $Ca_3(PO_4)_2$ favors carryover. If fed continuously, will cause feed line deposits
Sodium Silicate (Water Glass)	Na_2SiO_3	Boiler metal coating	None	No value as internal treatment will actually form scale
Starch	$(C_6H_{10}O_5)_x$	Prevent feed line deposits. To coat scale crystals, to prevent adherence	Some slight success due to slimy coating	No control. Inert with respect to hardness removal. Breakdown under heat
Tannin	Organics of varying constitution	Prevent feed line deposits. To coat scale crystals, to prevent adherence	Used with soda ash and phosphates in carbonate-organic treatment or phosphate-organic treatment	No control. Inert with respect to hardness removal. Breakdown under heat

According to general opinion, these conditions are caused by alkalinity, dissolved solids and suspended solids of the feedwater. It is thought that suspended solids concentration has a more pronounced effect than alkalinity or dissolved solids content. Oil and grease in boiler water definitely add to increased carryover.

When carryover is caused by high solids content, it usually can be controlled by blowdown. Increasing solids content generally is the result of insufficient blowdown. If blowdown rate increase can be accomplished economically, carryover generally can be controlled; but if it is not practical to increase blowdown rate, then chemical methods of water treatment will have to be established for carryover control.

When carryover is caused by oil in the feedwater, a method for its removal will have to be established. All oil removal methods are external; none are carried out within the boiler.

EMBRITTLEMENT

Embrittlement is a term used to denote boiler failure due to development of a crack in the plates. The character of this crack is designated as intergranular or intercrystalline and is said to result from a combination of stress and chemical attack.

Several causes of embrittlement have been suggested, among which are stress of boiler metal, boiler water leakage, and the fact that the boiler water itself will attack the boiler metal. Relative to the chemical character of the boiler water and its resultant embrittlement tendencies, it is generally believed that caustic soda and silica are the boiler water constituents most likely to cause this phenomenon.

Until the work of Schroeder and Berk (3), it was thought that caustic soda was the only cause, but they revealed that embrittling action was dependent on the presence of silica in addition to caustic soda.

Although silica is found in all natural waters, caustic soda as such is not present naturally. However, the sodium bicarbonate content of natural water upon heating in a boiler will break down to form caustic soda:

$$2NaHCO_3 = Na_2CO_3 + H_2O + CO_2$$

$$Na_2CO_3 + H_2O = 2NaOH + CO_2$$

Table 3 — Recommended Sulfate-Alkalinity Ratios for Embrittlement Prevention

Working Pressure of Boiler Lb. Gage	Recommended Sulfate to Alkalinity Ratios	
	Sodium Sulfate	Total Sodium Hydroxide and Carbonate Alkalinity, Calculated to Equivalent Sodium Carbonate
0 to 150	1	1
150 to 250	2	1
250 and over	3	1

Sodium bicarbonate is not only found in natural waters, but also in treated waters. When calcium and magnesium exist in water as the bicarbonates and this water is zeolite softened, calcium and magnesium are removed from the water by the zeolite and replaced with sodium of the zeolite as sodium bicarbonate. Sodium carbonate derived from lime-soda softening will also break down to form caustic soda.

In general, intercrystalline cracking occurs only in joints and seams in which certain dissolved solids may become highly concentrated. From studies of the occurrence of caustic embrittlement, it was found that the condition did not take place when a certain minimum amount of sulfate was present. On this basis, the maintenance of a minimum ratio of sulfate to alkalinity principle was established.

According to Section VII of the 1941 ASME Boiler Construction Code, "Caustic embrittlement has taken place in cases where the boiler water contains but little sodium sulfate in proportion to the total sodium hydroxide and sodium carbonate alkalinity. Operating evidence, supplemented by laboratory work, indicates that if not less than the ratios (in Table 3, based on 1941 ASME boiler code) of sodium sulfate to total sodium hydroxide and sodium carbonate alkalinity calculated to equivalent sodium carbonate are maintained in the boiler water, caustic embrittlement will be inhibited."

As a result of more recent investigations, it has been learned that maintenance of the ASME sulfate-carbonate ratio will not always prevent embrittlement. However, other ratios have not replaced those of the ASME, and consequently, they are still in practice in some instances.

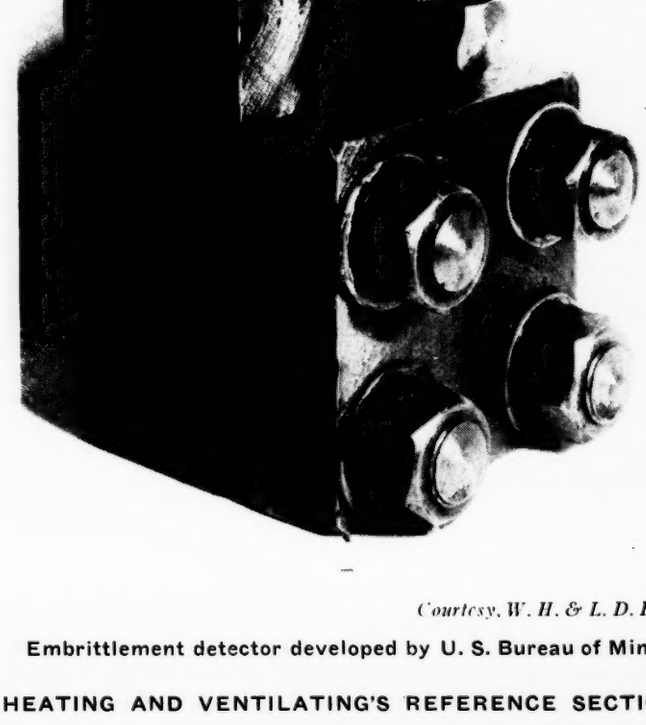
A recent development in embrittlement prevention is a procedure combining control of pH and phosphate content of boiler water. Early work indicated that the presence of phosphate would prevent embrittlement, but it was later found that this substance alone was of little value. However, if pH and phosphate content are simultaneously controlled so that the pH of the boiler water is never higher than that of a trisodium phosphate solution of the same phosphate concentration, the boiler water would lose its embrittlement tendencies.

As stated, caustic soda is the primary chemical cause of embrittlement and is present in the boiler water as a result of breakdown of sodium bicarbonate and carbonate, or has been added as caustic in the control of corrosion. Since it is desirable to use a water with no caustic alkalinity and yet avoid low pH values in order to prevent corrosion, a suitable water can be obtained by the use of trisodium phosphate which will maintain the pH above corrosive tendency values and yet will not contribute any caustic alkalinity to the water.

Inhibitors

Certain materials for preventing embrittlement are used as inhibitors. Of these some tannins have become quite popular. The use of such a material is generally controlled by maintaining a definite tannin-sodium hydroxide ratio in the boiler. Use of tannins may produce a color high enough in the boiler water to interfere in colorimetric tests.

Sodium nitrate is also being used to prevent embrittlement. The control basis of the procedure is maintenance of a definite sodium nitrate-sodium hydroxide ratio in which the nitrate may be fed continuously to the feedwater or to the boiler itself. Inasmuch as a small amount of sodium nitrate will accelerate embrittlement while a larger amount will inhibit the phenomenon, it follows that control of the process must be carefully attended. In the early stages of the development of this method, it was thought decomposition of the nitrate might result in the formation of ammonia which would be entrained with the steam. However, analysis of steam samples has indicated no appreciable increase in ammonia content.



Courtesy, W. H. & L. D. Betz

Embrittlement detector developed by U. S. Bureau of Mines.

The list of embittlement inhibitors now in use is large and includes sodium sulfiite, sodium and potassium zincate, and chromate and various lignin materials.

WATER SOFTENING

Of the several methods of water softening in use, the hot and cold lime-soda procedures are quite common. These methods are essentially the same except that the hot process is carried out at a temperature of 200 to 212F and is used mainly for industrial water conditioning, while the cold process is carried out at ordinary temperatures with its main use being in the municipal water treatment field. The chemistry involved and the reactions taking place are the same in both methods.

According to Hoover (4), the hot process has certain advantages over the cold method. These are:

(1) That part of the total hardness due to bicarbonates of calcium and magnesium is removed by heating.

(2) At the high temperatures of the process, the chemical reactions proceed more rapidly and are more complete.

(3) The precipitates are more crystalline and settle more rapidly than those produced in the cold process.

(4) The apparatus necessary is usually smaller and requires less housing.

(5) A lower hardness water may be obtained without the use of excess lime and soda ash which results in lower alkalinities in the product.

Chemical Reactions

The two chemicals used in lime-soda softening are lime or calcium hydroxide (hydrated lime) and soda ash or sodium carbonate. Calcium hydroxide of high purity is usually employed when the quantity of water to be treated is not too great. Unslaked lime, CaO, can be slaked to calcium hydroxide, $Ca(OH)_2$, in a continuous process and used as produced.

The carbonate hardness composed of the bicarbonates of calcium and magnesium are precipitated as calcium carbonate and magnesium hydroxide, both of which may be removed by settling and/or filtration. The reactions for this are:

$$Ca(HCO_3)_2 + Ca(OH)_2 = 2CaCO_3 + 2H_2O$$

$$Mg(HCO_3)_2 + 2Ca(OH)_2 = Mg(OH)_2 + 2CaCO_3 + 2H_2O$$

Calcium hydroxide will also react with some of the non-carbonate hardness factors according to the following reactions:

$$MgSO_4 + Ca(OH)_2 = Mg(OH)_2 + CaSO_4$$

$$MgCl_2 + Ca(OH)_2 = Mg(OH)_2 + CaCl_2$$

The calcium sulfate and chloride formed in these reactions are soluble, and as such, constitute calcium non-carbonate hardness which generally is also present naturally. These materials are removed by the use of soda ash as follows:

Courtesy, W. H. & L. D. Betz

Condition of an effluent line from a lime-soda water softener.

$$CaSO_4 + Na_2CO_3 = CaCO_3 + Na_2SO_4$$

$$CaCl_2 + Na_2CO_3 = CaCO_3 + 2NaCl$$

By these reactions, it is revealed that although the carbonate and non-carbonate hardness are removed, the total dissolved salt content of the water is not materially decreased as soluble sodium sulfate and chloride are produced which remain in the water.

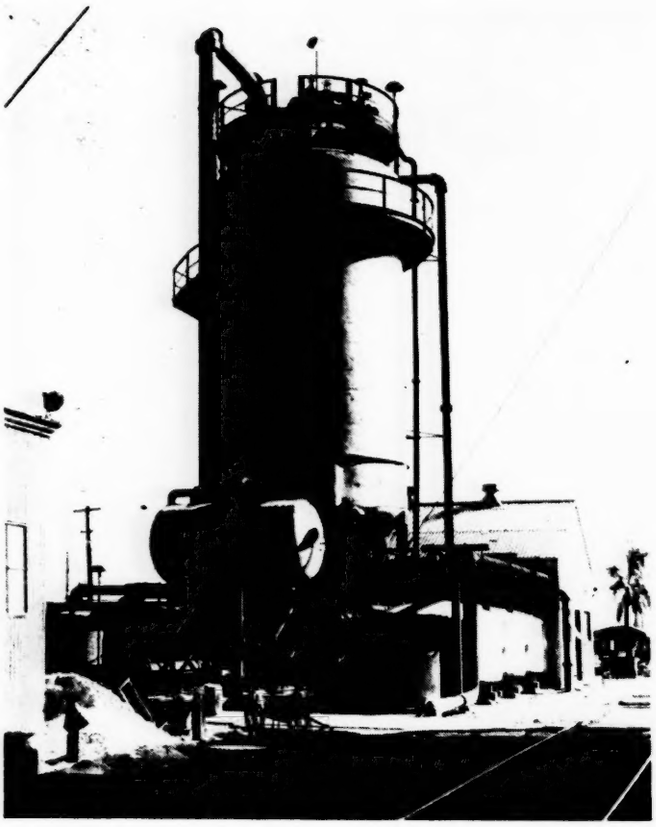
In some instances, caustic soda, NaOH, may be used to precipitate the carbonate hardness as:

$$Ca(HCO_3)_2 + 2NaOH = CaCO_3 + Na_2CO_3 + 2H_2O$$

in which sodium carbonate is formed which can react with the non-carbonate constituents as in previous reactions. The precipitates formed in all cases may be removed by settling and filtration.

In the hot process, the water is heated to 200F to 212F before the application of chemicals. At this elevated temperature, the reactions are practically instantaneous and generally go to completion. By the use of the hot process, it is possible to accomplish softening, deaeration, silica removal and filtration of suspended materials.

In general, water softened by the cold process is incrustant or conducive to scale formation and unless it is stabilized, it most likely will deposit a scale. If the softening process is followed by sedimentation alone before the water is used, it quite likely will contain some suspended precipitate which will form scale in the boiler. Another factor contributing to the incrustant nature of lime softened water is after-precipitation. In the cold lime-soda process, some of the reactions take place rather slowly and do not reach completion within the period of treatment. It then follows that after sedimentation and filtration, since a chemical reaction will continue to completion unless otherwise stopped, that after-precipitation will occur.



Courtesy, Infilco, Inc.

Hot-Flow water softener installed for U. S. Sugar Corp.

As a result of this scale forming tendency of a lime softened water, it is said to be unstable.

There are several ways in which the water can be stabilized. These are longer retention period to allow for reaction completion, treatment with an acid or acid salt, recarbonation or treatment with sodium hexametaphosphate.

A longer retention period permitting reaction completion necessitates tankage and basin capacity usually not available. Application of an acid salt such as alum converts the alkalinity into sulfate and also coagulates suspended precipitates. Sodium hexametaphosphate has been used successfully in preventing after-precipitation of calcium carbonate.

Recarbonation for Water Stabilization

The usual method of water stabilization is by recarbonation or the application of carbon dioxide gas to the softened water. The chemistry involved is shown in the following three reactions:

$$Ca(OH)_2 + CO_2 = CaCO_3 + H_2O \quad (1)$$

$$CaCO_3 + CO_2 + H_2O = Ca(HCO_3)_2 \quad (2)$$

$$Mg(OH)_2 + 2CO_2 = Mg(HCO_3)_2 \quad (3)$$

The first of these reactions will take place when the excess lime which has been added to the water in softening is changed by the carbon dioxide to insoluble calcium carbonate which is generally removed by sedimentation.

Reactions 2 and 3 represent the changing of the insoluble residual calcium carbonate and magnesium hydroxide to soluble calcium and magnesium bicarbonates. When recarbonation is carried out after filtration, the insoluble calcium carbonate and magnesium hydroxide will deposit in the filter resulting in cementation of the sand granules. Other filter operating difficulties will occur but after-deposits in the distribution system will be prevented. When pre-filtration recarbonation is practiced, the filter will be protected, but the final hardness of the water will not be as low as when recarbonation is a post-filtration procedure.

Recarbonation is generally controlled by determination of pH saturation and Langelier's saturation index. For more information on this subject, it is suggested that Langelier's (5) original article be consulted, and that of Hoover (6) in which the practical application of Langelier's method is explained.

Hot Phosphate Process

Another popular method of water softening is the hot phosphate process in which the calcium and magnesium salts are precipitated by the use of a phosphate and caustic soda at a temperature of 212F or higher. By this method, it is possible to obtain a product of almost zero hardness. Silica may be removed during softening by the use of magnesium sulfate. The phosphates used may range from trisodium phosphate to phosphoric acid.

The chemistry involved in the process follows:

$$3Ca(HCO_3)_2 + 6NaOH = 3CaCO_3 + 3Na_2CO_3 + 6H_2O$$

$$3CaCO_3 + 2Na_3PO_4 = Ca_3(PO_4)_2 + 3Na_2CO_3$$

In these reactions, it is shown that the calcium bicarbonate is changed to insoluble calcium carbonate which in turn is converted to the more insoluble tricalcium phosphate by reacting with trisodium phosphate. Magnesium hardness is changed to the insoluble hydroxide by caustic soda simultaneously with the conversion of calcium bicarbonate to the carbonate.

It can be seen in these reactions that alkalinity of the water is increased, not only by the addition of alkaline trisodium phosphate, but by the resultant sodium carbonate formed. In some instances, the increased alkalinity may not be desired and may be avoided by the use of phosphoric acid. The reactions then are as follows:

$$Ca(HCO_3)_2 + H_3PO_4 = CaHPO_4 + 2CO_2 + 2H_2O$$

The carbon dioxide is generally removed by deaeration after which sodium hydroxide is added to complete the reaction as follows:

$$3CaHPO_4 + 3NaOH = Ca_3\ PO_4)_2 + Na_3PO_4 + 3H_2O$$

Non-carbonate hardness can be removed by this process in the following manner:

$$3CaSO_4 + 2Na_3PO_4 = Ca_3(PO_4)_2 + 3Na_2SO_4$$

$$MgCl_2 + 2NaOH = Mg(OH)_2 + 2NaCl$$

Softening by Zeolite

Zeolite water conditioning is a process of ion-exchange which has become increasingly popular in the last few years. There are three types of zeolites:

Siliceous, organic and acid absorbent. A siliceous zeolite is capable of replacing calcium or magnesium ions in the water by sodium ions from the zeolite's structure while the organic substances replace calcium and magnesium ions in the water by sodium or hydrogen ions. The acid asborbent materials remove anions from water.

In zeolite conditioning, no chemicals are added to the water. The water is percolated through a bed of zeolite in a unit resembling a pressure filter in which the zeolite takes the place of the sand. After a period of service as a softening agent, the zeolite must be regenerated and washed after which it is in condition for further use.

Zeolites in general are hydrated silicates of sodium and aluminum having a formula, $Na_2O.Al_2O_3.SiO_2$. The first zeolite used was a green sand which occurs naturally. At the present time, most of the zeolites in use are synthetic resinous compounds. The reactions of sodium zeolite softening are:

$$Ca(HCO_3)_2 + Na_2Z = 2NaHCO_3 + CaZ$$
$$Mg(HCO_3)_2 + Na_2Z = 2NaHCO_3 + MgZ$$
$$CaSO_4 + Na_2Z = Na_2SO_4 + CaZ$$
$$MgSO_4 + Na_2Z = Na_2SO_4 + MgZ$$
$$CaCl_2 + Na_2Z = 2NaCl + CaZ$$
$$MgCl_2 + Na_2Z = 2NaCl + MgZ$$

When the zeolite has lost its ability to exchange more sodium ions, it must be regenerated which is accomplished by washing the zeolite with strong sodium chloride solution, in which the above reactions are reversed:

$$\begin{matrix} CaZ \\ MgZ \end{matrix} + 2NaCl = Na_2Z + \begin{matrix} CaCl_2 \\ MgCl_2 \end{matrix}$$

After contact with the brine, the zeolite is washed with clean water which removes the calcium and magnesium chlorides and the excess sodium chloride.

The organic or hydrogen zeolites are capable of replacing calcium, magnesium, sodium and other cations or positive ions by hydrogen. This type of zeolite is regenerated by acid, usually sulfuric, followed by rinsing. The reactions of the softening process are:

$$Ca(HCO_3)_2 + H_2Z = CaZ + 2H_2CO_3$$
$$CaSO_4 + H_2Z = CaZ + H_2SO_4$$
$$CoCl_2 + H_2Z = CaZ + 2HCl$$

Similar reactions take place with the above compounds of magnesium and sodium.

In regeneration, the following reaction takes place:

$$CaZ + H_2SO_4 = H_2Z + CaSO_4$$

While hardness is removed in sodium zeolite softening, alkalinity or total solids are not reduced; whereas, hydrogen zeolite softening not only removes hardness, but also removes bicarbonate alkalinity without substituting any salts and thus the total solids content is decreased. This removal of bicarbonate alkalinity by hydrogen zeolite is its principal advantage.

In discussing water conditioning by the sodium and hydrogen zeolite processes, only the cations or positive ions of the water have been shown to be removed as these methods will not affect the anion content of the water. The negative ions or anions may be removed by a process known as anion exchange or more correctly anion adsorption. These ions can be adsorbed from solution when they exist in their acid forms such as HCl, H_2SO_4 or H_2O_3. The reactions involved are similar to that indicated below for sulfuric acid:

$$H_2SO_4 + RCO_3 = RSO_4 + CO_2 + H_2O$$
$$H_2SO_4 + R(OH)_2 = RSO_4 + 2H_2O$$

in which the zeolite material is represented by RCO_3 or $R(OH)_2$.

Regeneration is accomplished by the use of an alkaline reagent such as sodium carbonate or caustic soda. The reaction taking place during regeneration is

$$RSO + \begin{matrix} Na_2CO_3 \\ 2NaOH \end{matrix} = \begin{matrix} RCO_3 \\ R(OH)_2 \end{matrix} + Na_2SO_4$$

After regenerating, the zeolite must be washed with soft or distilled water as the alkalinity being washed out may precipitate calcium carbonate or magnesium hydroxide if rinse water containing calcium and magnesium is used. If the water contains an excess amount of sodium salts, free acid or iron, then zeolites cannot be used with good results unless the water is first treated for each condition mentioned.

Silica Removal

There are two silica removal methods, the hot and cold processes. The hot process involves the use of a magnesium reagent such as magnesium sulfate, carbonate or oxide, calcined magnesite or dolomitic lime and is carried out in a hot process lime-soda softener. Magnesium oxide is generally used as it does not increase the solids content of the water.

The efficiency of the removal depends upon several factors: temperature; retention time; pH; sludge recirculation and the type of magnesium reagent used.

The amount of silica removed increases with increase in temperature up to the usual temperature of the hot lime-soda softening process at which temperature a retention period of about 15 minutes will effect a practically complete removal. However, at lower temperatures, the amount of silica removed increases with increase in retention time. When large amounts of silica are removed, the effect of pH is almost a straight line function; but when the amount is less, the influence of pH is shown to be a rising and falling curve—the peak of which coincides with the usual optimum pH of 10.1.

Recirculation of partially spent magnesium oxide sludge contacting silica-bearing water will usually result in an increased removal efficiency. This procedure also reduces somewhat the demand for fresh magnesium oxide reagent. The amount of silica removed is not directly proportional to the amount of reagent used but follows the rule of diminishing return. In other words, if X pounds of reagent will remove Y pounds of silica, 2X pounds of reagent will not remove 2Y pounds of silica but will probably require 3X pounds of reagent, etc.

In the cold process, silica is removed by the use of

ferric compounds. This process can be carried out in conventional sedimentation basins. Ferric sulfate is the popular reagent.

The amount of silica removed in the cold process with iron compounds decreases with increase in temperature. An increased retention period is desirable. At a pH of 9.0, it has been found that silica removal is most effective. The principle on which the process is based is that of adsorption.

Oil Removal

Oil in boiler water is not desirable for it retards heat transfer and can combine with boiler water sludge to form a thick pasty mass. Oil will also contribute to foaming.

Oil removal is generally an external process and can be accomplished by physical or chemical methods. The usual type of equipment employed in physical removal methods is a separator of the baffle or centrifugal type. The baffle type device separates oil from the steam which is caused to impinge on a baffle resulting in deposition of moisture and oil on the baffle while the de-oiled steam passes on through the separator. Condensed water and oil drip from the baffle into a drain. These baffles have no utility in the removal of oil from liquids.

Separators working on a pressure filter principle have been used to some extent for the removal of oil from boiler water. These consist of a metal drum in which there is located one or more concentric rings wrapped with wire mesh rope. The water is forced through the drum and its rings during which passage the oil coalesces on the wire mesh rope and collects in drawoff sumps. Another type of separator, recently reported, employs sedimentation of solids and vaporization of the oil in conditioning the water.

Various types of ordinary filters have been developed which employ sponges, burlap, terry cloth or other such course filter media. Oil removal by these filters is purely a physical process and requires frequent replacement of the filtering medium.

Methods of oil removal so far discussed are concerned mainly with free oil. When the oil is emulsified, chemical methods may be employed. In these, the coagulating agents such as alum and iron salts are used to coagulate the finely dispersed oil. An alkali is generally fed with the coagulant. After settling, the water is filtered through a pressure type filter filled with anthracite coal instead of the usual filter sand. Backwashing is accomplished by the use of hot water.

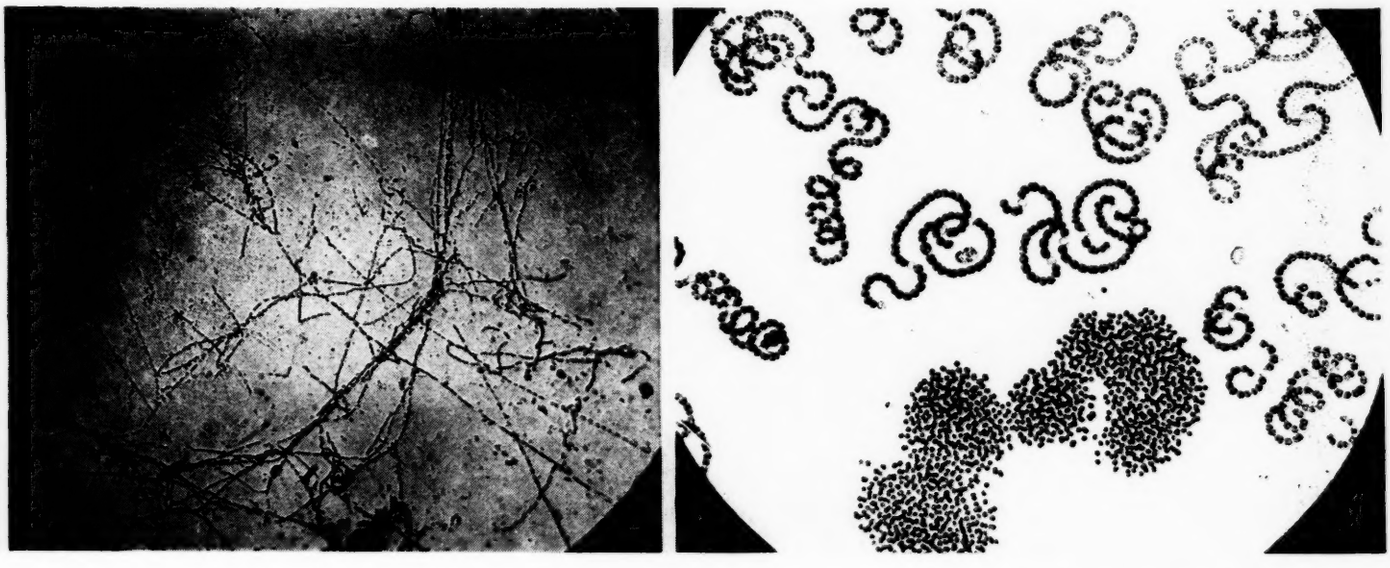
SLIME AND ALGAE

Another difficulty encounted in boiler operation, heat exchange, condenser and air conditioning equipment is slime deposition and algae growth. Algae are microscopic organisms almost always found in surface waters and sometimes in ground waters. There are many types which, according to one method of classification, are grouped according to their colors; the greens; blues; blue-greens; reds and yellows.

Some of these forms are free floating while others are sedentary and exhibit colonial growth, resulting in long filaments or film deposits. Deposits of these organisms on heat exchange surfaces interfere greatly with heat transfer as they tend to insulate any surface they cover. In pipe lines and other ducts, their growth will decrease the effective diameter of the passage, thus decreasing the carrying capacity.

There is a difference between a slime deposit and an algae growth. The slime deposit is usually more gelatinous and more adherent to its surface and in addition to containing simple organisms, may include organic and inorganic debris and scale-forming salts.

These deposits can be controlled mechanically or chemically. The mechanical method is nothing more



Courtesy, New York City, Department of Water Supply, Gas and Electricity

Left, photomicrograph of crenothrix or iron bacteria which is often found growing in mains and conduits as well as in wells. Right, two forms of algae growth. Upper, anabaena, a bluegreen organism, lower, clathrocystis or microcystis, also a bluegreen growth.

than removal of the deposits by manual methods. This practice is costly and is not too satisfactory as certain inaccessible surfaces within equipment may not be reached.

Methods of Control

Chemical methods of control are the most satisfactory and only by them can control be maintained continuously. The procedure may be carried out on the fresh feedwater or on recirculated water if this is practical. At the present time probably the most popular agents used for the control of these organisms are copper sulfate, chlorine gas, and chloramines. Some experimental work has been done on the effect of DDT and 2, 4-D and other newly developed agents, but present evidence is not sufficient to predict their usefulness.

Copper sulfate is a common material and is easy to apply, either as a solid material to lakes, ponds and treatment structures or as a solution by injection feed into the distribution system. It is the copper ion which is toxic to these organisms and since copper sulfate is the cheapest of the copper salts, it is the most widely used. Copper salts are also toxic to fish and when applying the chemical to a lake or pond, it is rather important that the type of organisms be identified and the killing dose determined so as to not only control the organisms but to minimize the harm to fish. For the more common forms of algae, the killing dose may range from one to eight pounds of copper sulfate for one million gallons of water. Copper salts are ineffective in highly alkaline waters as the copper ion is precipitated as copper hydroxide. It is desirable to treat the water before it enters the heat exchange system, so that the resulting dead organisms may settle in a lake, pond or settling basin. In the system, organic matter may settle on heat exchange surfaces and defeat the purpose of the treatment.

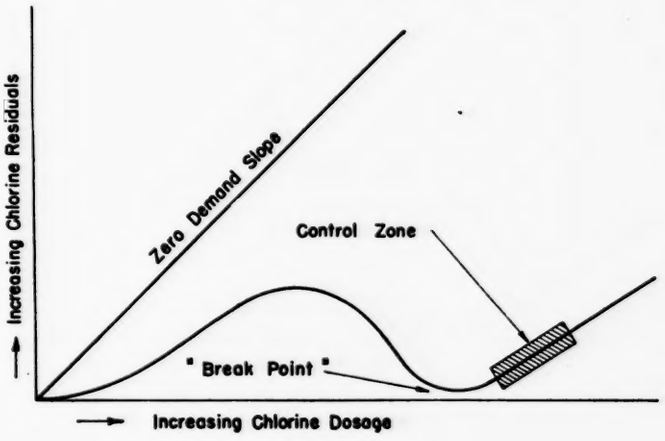
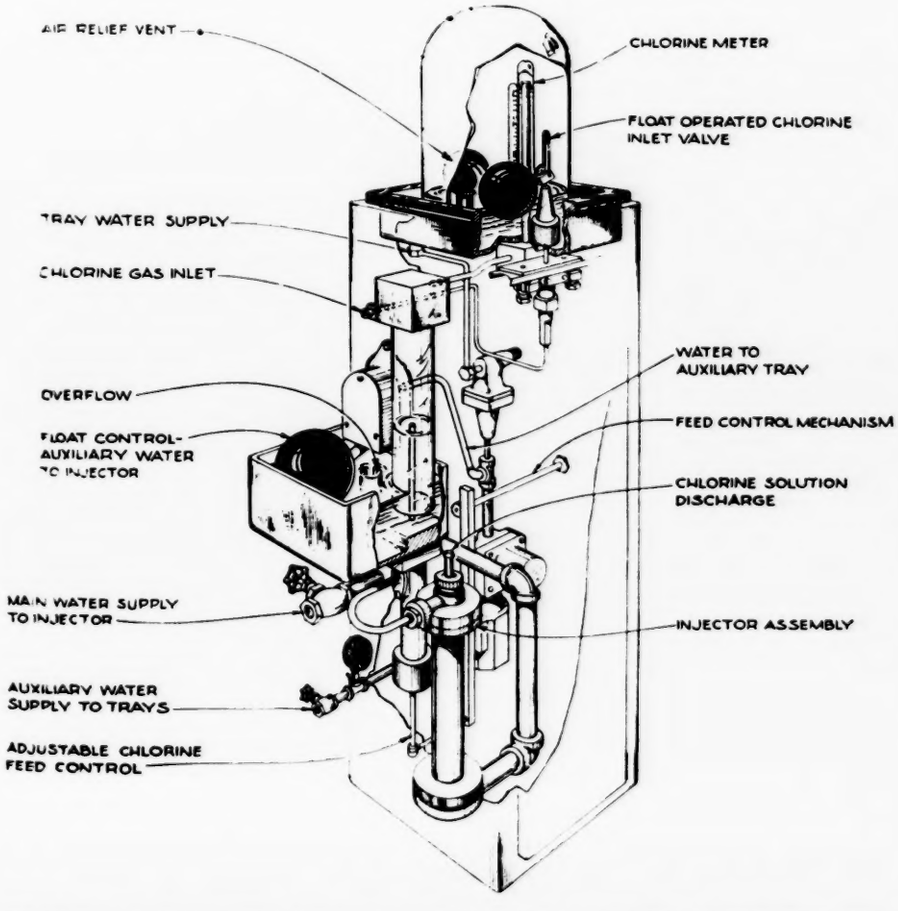


Diagram to illustrate break-point chlorination.

If chlorine is the reagent to be used, chlorine gas should be fed rather than a chlorine-bearing compound such as chorinated lime or calcium hypochlorite. The latter compounds at best contain only about 70% available chlorine as such, and their use introduces a large amount of solids into the water which should be removed.

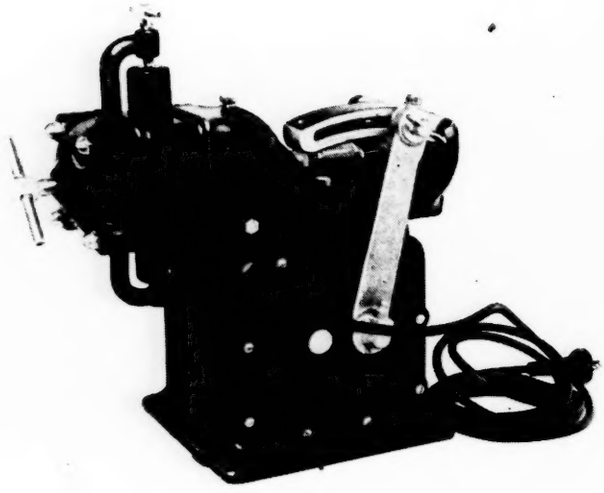
Chlorine gas is highly toxic to algae and bacteria and by its use the water is not only freed of algae, but is also sterilized. Chlorine may be fed continuously or intermittently. The latter is preferred by some and is referred to as shock treatment in which a dose of chlorine greatly in excess of that actually needed is fed at intervals during the day. Adherents of this practice report very satisfactory results.

By the use of special feeding machines, any desired dose may be fed continuously. To know how much chlorine to feed, the chlorine demand of the water should be known. This determination is a simple procedure in which various doses of chlorine are applied to a series of samples in which the residual chlorine is determined after a predetermined reaction period. It is also advisable to determine the type of algae present and find its toxic dose in the literature. For this purpose, it is suggested that Whipple (7) and Hale (8) be consulted.



Illustrations on page 109 and 110, courtesy, Wallace & Tiernan Co., Inc.

Operating diagram of a visible vacuum chlorinator, type MSV-M



Chemical reagent feeder, electrically operated.

Breakpoint Chlorination

A recently developed chlorination practice is the breakpoint process (9) in which all of the organic matter in the water is oxidized. In the feeding of chlorine to water, it was learned that when the applied chlorine dose is plotted against the residual chlorine, a curve is obtained which shows an increase in residual with increased dose until a certain point. Beyond that the residual decreases with increasing dosage, after which the residual again increases. The break in the curve is the breakpoint which indicates that at this point, all organic material has been oxidized and subsequent residual is due to free chlorine.

The efficiency of chlorine has been explained on the basis of its being a powerful oxidizing agent. When chlorine is fed to water, hydrochloric and hypochlorous acids are formed. The latter being unstable, breaks down into hydrochloric acid and nascent oxygen which is then available for oxidation. The following reactions demonstrate the action of chlorine in water:

$$H_2O + Cl_2 = HCl + HOCl$$
$$HOCl = HCl + O$$

Chloramines

The use of chloramines depends upon the application of chlorine and ammonia to the water in the ratio of 1 to 4 to form these compounds. There are three chloramines, NH_2Cl, $NHCl_2$, and NCl_3, the formation of which is dependent upon the pH maintained. At the usual pH values maintained in water conditioning, a mixture of NH_2Cl and $NHCl_2$ will result, although the monochloramine is the desired compound. Between pH limits of 4.4 to 8.0, there will occur a gradual shifting equilibrium of di- and monochloramine. In other words, as the pH changes from 4.4 to 8.0, the proportion of monochloramine increases while that of dichloramine decreases (10).

The chloramines are oxidizing agents but are not as powerful as chlorine alone. The affect of chloramines persists longer in water than that of free chlorine; and although they are not as fast in action as chlorine, a greater residual of chloramine than free chlorine can be maintained without taste production.

In some cases of municipal water sterilization it has been reported that the use of chlorammoniation seemed to stimulate the growth of spore-forming organisms. This was believed due to the breakdown of the chloramine, releasing ammonia which is known to be a nutrient for such organisms. Although this is only theory, the accelerated growth of these organisms could have been due to an excess of uncombined ammonia in the water.

Sodium pentachlorphenate has been reported to be effective in the control of slime and algae deposits. This chemical is stable in alkaline waters in which copper and chlorine would be reduced in efficiency. This chemical is also effective against organisms which are not affected by copper and chlorine. This material may be used in shock treatment. A disadvantage is that as it is toxic to humans, it requires careful handling, and of course, it cannot be used in domestic supplies.

In the control of slime deposits due to growth of microscopic organisms, it is generally stated that these organisms will build up an immunity to certain control agents, and in time, will not be further affected. It has been found that in the so-called shock treatment in which the control chemical is applied intermittently, the organisms are less likely to become immune. If immunity is attained, it will take place over an extended period of time rather than in the comparatively short period under continuous treatment. If in any method of treatment, the organisms become immune to one chemical, their growth can be controlled by resorting to a different killing agent.

It is again emphasized that water is a quite variable substance occurring in nature; and that for all practical purposes, no two waters can be considered as the same. It then follows that one method of water treatment will not be suitable for all waters even if all were intended for the same use. This then is the first reason why one should know the character of the available water supply to apply the treatment which will most economically provide a satisfactory product.

Secondly, a knowledge of the character of the water is necessary in selecting the treatment method which will produce a water least injurious to the equipment with which it comes in contact in addition to its being suitable for its intended use such as steam production. It may be quite possible to produce a satisfactory steam from a water which will be injurious to the boiler surfaces or vice versa. The problem, therefore, resolves itself into one of learning the character of the raw material, in selecting a method for its treatment in the production of a suitable end product, and protection of process equipment.

In view of the fact that many volumes have been written dealing with the intricacies of water and its treatment, it is not possible in an article of this kind to cover each phase of the subject adequately. An attempt has been made in this article to point out the major problems associated with the use of water in heating and air conditioning including an outline of

the various treatment methods and the principles upon which they are based. The variation in water character has been emphasized to bring out the need for preliminary study before selecting a treatment method.

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Sizing Exhaust System Mains at Branch Junctions

F. A. STANTON and **H. M. NICHOLS**

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IN layouts for duct systems for grinding, polishing and buffing operations, refuse removal in woodworking plants, and similar applications, it is usual practice to make the branches connecting to the hoods the same size as the throat openings at the hood connections, and to size the main duct so that its area at any point is between 20 to 25% greater than the sum of the areas of the hood connections between the point in question and the start of the duct system.

Some of the reasons for the oversize mains are: to reduce the friction loss in the main, improve the air balance of the system, and also provide additional carrying capacity in the main so that some additional machines may be connected at a later date without seriously upsetting the performance of the exhaust system. With oversize mains usually a reasonable number of added connections can be accommodated by a moderate increase in fan speed and horsepower.

Also some state industrial codes governing the installation of exhaust systems for grinding, polishing and buffing wheel exhaust systems require oversize mains, as for instance the New York State code which requires a 20% increase in mains for grinding, polishing, and buffing exhaust systems.

When branches are the same area as the hood connections, the diameter of the main duct at each point where branches are joined to it is determined by adding the areas of all the entering branches from the start of the system to the point in question, and then adding 20 to 25% to determine the area of the main duct at the given point. With the area of the main duct determined, it is then necessary to obtain the corresponding diameter taking the nearest whole inch dimension.

The accompanying chart considerably simplifies the solving of this problem of determining the diameter of the main duct at the various sections, as the results can be read directly from the chart without the aid of mathematical computations.

On the chart the bottom scale represents the diameter of the main up to the point of entrance of the branch. The two vertical scales represents diameter of entering branch for two conditions, one where it is desired to make the main 20% oversize and the other where it is desired to make the main 25% oversize. The curved lines on the chart represent the proper diameter of the main duct to accommodate the added branch connection.

The chart is used by following along the horizontal and vertical scales until they intersect, and at that point determining the nearest reading on the circular lines which represent the diameter of the increased main.

As an illustration, assume a 5-in. branch at the start of the exhaust system. In this case the previous main is zero so we read up from the zero line on the horizontal scale until we intersect the 5-in. line on the vertical scale and using the plus 25 vertical scale we read 6 in. (nearest whole inch size) diameter on the circular scale for the diameter of main. Now assume our next branch connection is 8 in. in diameter. Reading up from our established main diameter of 6-in. until we intersect the 8-in. vertical scale we obtain a main diameter of 11 in. This process is continued until the entire main is sized without the necessity of any mathematical calculations.

(Chart is on page 112, following)

Chart for determining diameter of main after each branch junction.

SELECTION OF V-BELT DRIVES

(Continued from last month's data sheet)

Table 3. V-Belt Sizes for Various Loads

RPM of Smaller Pulley	Horsepower									
	½	1	2	3	5	7½	10	15	20	30
	Section Designation									
4000	A	A	A	A	A	A	A	A	A	B
3500	A	A	A	A	A	AB	AB	AB	AB	B
3000	A	A	A	A	A	AB	AB	AB	AB	B
2500	A	A	A	A	A	AB	AB	AB	AB	BC
2000	A	A	A	A	AB	AB	AB	AB	BC	C
1750	A	A	A	A	AB	AB	AB	BC	BC	CD
1500	A	A	A	AB	AB	AB	AB	BC	BC	CD
1250	A	A	A	AB	AB	AB	AB	BC	BC	CD
1000	A	A	A	AB	AB	AB	BC	BC	C	CD
900	A	A	AB	AB	AB	AB	BC	BC	CD	CD
800	A	A	AB	AB	AB	B	BC	C	CD	CD
700	A	A	AB	AB	AB	BC	BC	C	CD	CD
600	A	AB	AB	AB	B	BC	BC	C	CD	CD
500	A	AB	AB	AB	BC	BC	C	CD	CD	DE

Table 4. Nominal Horsepower Ratings per Belt

Belt Velocity, ft. per min.	Section Designation															
	A				B			C			D			E		
	Pitch Diameter, Small Pulley, Inches															
	2.6	3.4	4.2	5.0	5.0	5.8	6.6	7.0	9.0	11.0	12.0	14.0	16.0	21.0	23.0	25.0	27.0
	Nominal Horsepower per Belt																
1000	.5	.8	.9	1.0	1.3	1.5	1.7	2.0	2.8	3.4	4.5	5.6	6.5	8.5	9.4	10.2	10.9
1500	.8	1.1	1.4	1.5	1.8	2.1	2.4	2.9	4.2	5.0	6.5	8.2	9.6	12.5	13.9	15.1	16.1
2000	1.0	1.5	1.8	2.0	2.4	2.8	3.1	3.7	5.5	6.5	8.4	10.7	12.5	16.2	18.1	19.6	21.0
2500	1.1	1.7	2.1	2.4	2.8	3.3	3.7	4.5	6.6	8.0	10.1	12.9	15.1	19.6	21.9	23.9	25.5
3000	—	2.0	2.4	2.7	3.2	3.8	4.3	5.0	7.6	9.2	11.4	14.9	17.5	22.7	25.3	27.6	29.6
3500	—	—	2.7	3.0	3.4	4.1	4.7	—	8.4	10.3	12.4	16.5	19.5	24.9	28.1	30.8	33.1
4000	—	—	2.8	3.3	3.5	4.4	5.0	—	9.0	11.2	—	17.6	21.0	26.6	30.3	33.4	36.0
4500	—	—	—	3.4	3.5	4.4	5.1	—	—	11.8	—	—	22.1	—	31.7	35.2	38.2
5000	—	—	—	3.4	3.3	4.3	5.1	—	—	12.2	—	—	22.6	—	—	36.2	39.5

Table 5. Correction Factor for Sheave Arc of Contact

Arc of Contact	180°	170	160	150	140	130	120	110
Multiplier	1.00	.98	.95	.92	.89	.86	.83	.79

CONVERSION OF PRESSURE UNITS

Ounces Per Square Inch to Inches of Water

Pressure, Ounces per Square Inch	Decimal Parts of an Ounce									
	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
	Inches of Water									
0	—	0.17	0.35	0.52	0.69	0.87	1.04	1.21	1.38	1.56
1	1.73	1.90	2.08	2.25	2.42	2.60	2.77	2.94	3.11	3.29
2	3.46	3.63	3.81	3.98	4.15	4.33	4.50	4.67	4.84	5.01
3	5.19	5.36	5.54	5.71	5.88	6.06	6.23	6.40	6.57	6.75
4	6.92	7.09	7.27	7.44	7.61	7.79	7.96	8.13	8.30	8.48
5	8.65	8.82	9.00	9.17	9.34	9.52	9.69	9.86	10.03	10.21
6	10.38	10.55	10.73	10.90	11.07	11.26	11.43	11.60	11.77	11.95
7	12.11	12.28	12.46	12.63	12.80	12.97	13.15	13.32	13.49	13.67
8	13.84	14.01	14.19	14.36	14.53	14.71	14.88	15.05	15.22	15.40
9	15.57	15.74	15.92	16.09	16.26	16.45	16.62	16.79	16.96	17.14
10	17.30	17.47	17.65	17.82	17.99	18.17	18.34	18.51	18.69.	18.87

Inches of Water to Ounces Per Square Inch

Pressure, Inches of Water	Decimal Parts of an Inch									
	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
	Ounces per Square Inch									
0	—	0.06	0.12	0.17	0.23	0.29	0.35	0.40	0.46	0.52
1	0.58	0.63	0.69	0.75	0.81	0.87	0.93	0.98	1.04	1.09
2	1.16	1.21	1.27	1.33	1.39	1.44	1.50	1.56	1.62	1.67
3	1.73	1.79	1.85	1.91	1.96	2.02	2.08	2.14	2.19	2.25
4	2.31	2.37	2.42	2.48	2.54	2.60	2.66	2.72	2.77	2.83
5	2.89	2.94	3.00	3.06	3.12	3.18	3.24	3.29	3.35	3.41
6	3.47	3.52	3.58	3.64	3.70	3.75	3.81	3.87	3.92	3.98
7	4.04	4.10	4.16	4.22	4.28	4.33	4.39	4.45	4.50	4.56
8	4.62	4.67	4.73	4.79	4.85	4.91	4.97	5.03	5.08	5.14
9	5.20	5.26	5.31	5.37	5.42	5.48	5.54	5.60	5.66	5.72
10	5.80	5.86	5.92	5.97	6.03	6.09	6.15	6.20	6.26	6.32

How to Control Carbon Monoxide in Garages

GEORGE HAMA

Bureau of Industrial Hygiene, Detroit Health Department.

Flexible duct tailpipe exhaust systems, which easily can be connected directly to automobile and truck exhaust pipes during stationary test, have been effective in controlling carbon monoxide concentrations in garages. Such systems are especially useful in winter when mechanics are reluctant to open windows and doors for adequate ventilation. Mr. Hama tells how to arrange good exhaust systems and gives the required design data.

THE results of air analyses for carbon monoxide in a large number of unventilated service garages during winter months indicate that carbon monoxide concentrations in the workers' breathing zone range from 0.005% to .04% carbon monoxide by volume. Mechanics employed in these garages report symptoms of carbon monoxide poisoning, such as headaches and dizziness, and not infrequently there have been cases of workers becoming unconscious. For an eight-hour exposure, concentrations of 0.01% carbon monoxide can be tolerated by most workers without symptoms of headache or dizziness.

In severe winter climates, the control of carbon monoxide in most service garages has not been practically effected by merely installing general exhaust ventilation systems for the purpose of diluting the carbon monoxide to a safe concentration. Without proper facilities for providing preheated make-up air, these necessarily large volume exhaust systems tend to expose the workers to high velocity cold drafts and low workroom temperatures. It has been our experience that few service garages have sufficient boiler or heating capacity to cope with the extremely cold winter days. It is on these days when doors and windows are tightly closed that carbon monoxide concentrations are at their maximum. Workers almost without exception prefer breathing air containing exhaust gases to turning on ventilation which may cool the workroom area.

Sources of exhaust gases from motor vehicles can be divided into two classes—transient vehicles in motion, and stationary vehicles whose motors are running for purposes of motor tuning, adjusting, etc. Inasmuch as large volumes of air are required for the control of carbon monoxide by general ventilation (5,000 to 10,000 cfm) with correspondingly high heat losses, our approach has been to control the carbon monoxide from the stationary cars as far as possible by local or tailpipe systems, and to require only sufficient general ventilation to dilute the carbon monoxide from the transient cars. This method conserves heat and provides partial control on the extremely cold days when general ventilation systems may be shut off to prevent cooling of the workroom area. General ventilation, when necessary, should be provided by a positive pressure, preheated fresh air supply system. This puts the garage under a slight positive pressure and tends to nullify cold drafts on mechanics from window cracks and door openings.

We have found that tight connections between the tailpipe and the exhaust duct interfere with motor tuning and require too much time for the mechanic to hook the system up. For this reason, a loose connection with sufficient airflow to control the exhaust gases under all conditions of motor operation is recommended. For a loose connection on a tailpipe with a flanged deflector, a box hood arrangement can be made, as shown in Fig. 1. Flexible ducts should be located at all positions where motors may be operated. The system can be either the overhead main duct type, as shown in Fig. 2, or the floor type connection with an underground main duct, as shown in Fig. 3. The latter type presents a better appearance; the overhead system is easier to maintain and is more accessible for use by the mechanics.

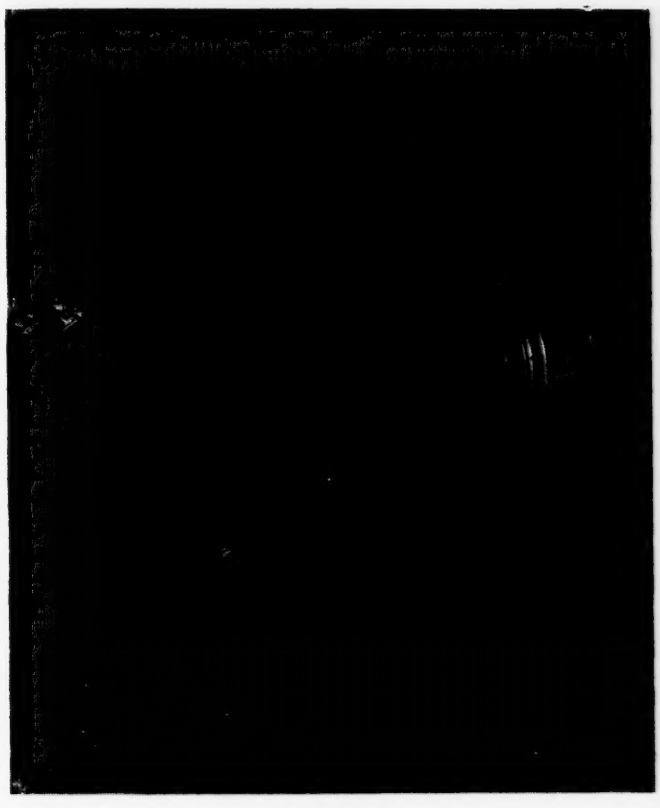


Fig. 1. Flexible duct and tailpipe connection for direct exhaust of automobile engines during indoor test.

The design data for these systems is given, as follows:

Table 1 – Minimum Airflow and Duct Diameters Required at Tailpipe

	Cfm per Tailpipe	Duct Diameter, Inches
Automobiles	100	2.5
Trucks	200	3.
Diesel Trucks	300	3.5

Table 2 – Estimated Resistance to Airflow for Flexible Ducts

Diameter of Duct	Friction in Inches of Water Per 100 Ft of Flexible Duct		
	100 CFM	200 CFM	300 CFM
2"	53	193	414
2½"	18	65	130
3"	7	26	56
3½"	2	12	26
4"	1	6	13

To give better distribution and to reduce friction losses, the main duct should not be tapered. A main duct air velocity of 2,000 fpm or less has been found satisfactory. For floor systems, the main duct has been constructed of soil pipe or tile crock, as shown in Fig. 4. On second story installations, floor systems have been installed by drilling through the floor and hanging the main duct from the ceiling of the floor below.

In most instances, centrifugal fans with pressure characteristics above 3 in. of resistance pressure water gauge are required. Floor duct systems require approximately 6 ft of flexible duct. Overhead systems require 10 to 15 ft of flexible duct. The average system will have a resistance pressure between 3 and 5 in. w.g. On floor duct systems with cap connections, it is well to size the fan and main duct for the severest conditions, that is, when all connections are in use.

The volume of exhaust gases produced by motor vehicle engines varies not only with motor revolutions per minute, but also with horsepower load on the motor and the gasoline consumption rate. Thus an automobile engine producing 10 cfm of exhaust gases at an engine speed equivalent to 20 miles per hour at no load motor tuneup conditions, may produce 15 cfm of exhaust gases at road load conditions at the same speed, and as high as 40 to 50 cfm under a full throttle dynamometer test load, also at the same motor speed. The usual operation of motor engines in service garages is done at no load conditions. Measurements of the volume of exhaust gases produced by a 100 hp light passenger car at no load conditions with normal carburetor setting indicates that approximately 1 cfm of exhaust gases is produced for each mile per hour of motor speed. Thus an engine speed equivalent to 20

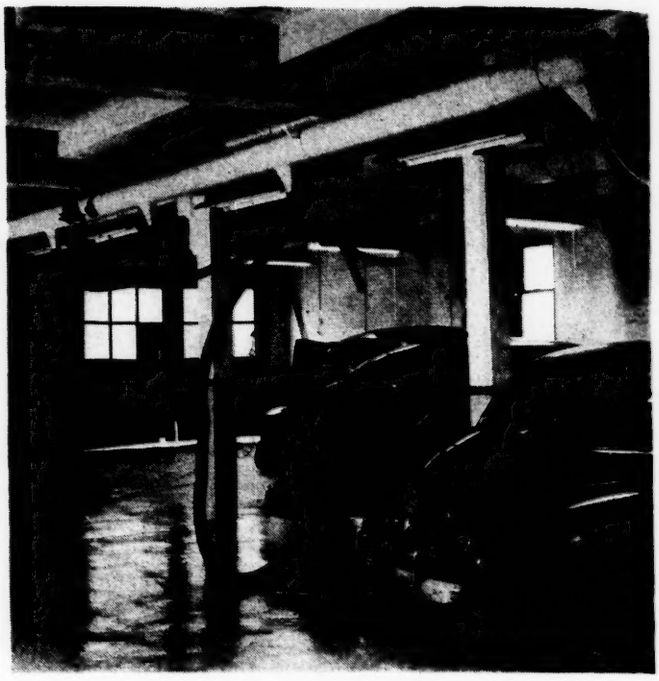


Fig. 2. Overhead main duct with flexible connections for engine exhaust.

miles per hour under no load conditions on this passenger car produced approximately 20 cfm of exhaust gases. Occasionally passenger cars are operated on dynamometer test rolls; under these conditions, the volume of exhaust gases produced is considerably higher. A very rough approximation of the volume of exhaust gases produced produced can be arrived at by allowing 2 cfm of exhaust gases per horsepower delivered.

The highest volume of exhaust gases during motor tuneup obviously will be given off during the momentary period of "gunning" or high rpm. We have observed that on passenger car test tuning rolls, momentarily "gunning" the motor seldom produces a motor speed exceeding an equivalent of 60 miles per hour. The 100 cfm exhaust volume for passenger cars has been found to give adequate control of exhaust

Fig. 3. Flexible duct connection to under-floor main exhaust duct.

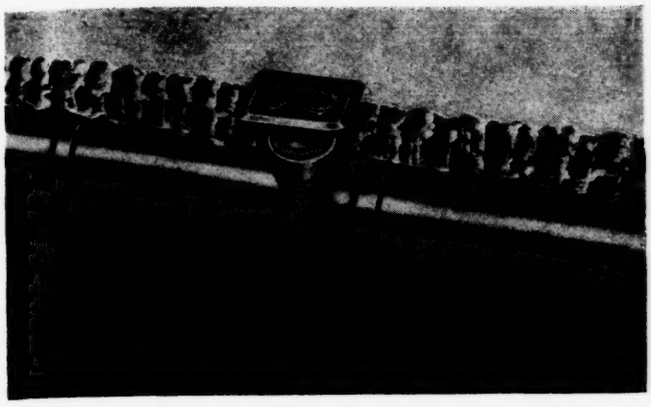


Fig. 4. Soil-pipe main-exhaust duct under-floor with spring-cap openings for flexible duct connection.

gases on both large and small passenger cars during "gunning" of the motor.

The 200 cfm airflow for tailpipe ducts on trucks has been found to be adequate for trucks with motor displacements up to 500 cu in. For motor trucks with displacements in excess of this, an airflow of 300 cfm is recommended. Diesel engines are generally of a larger displacement. Diesel engine exhaust gases contain irritating, obnoxious aldehydes and toxic oxides of nitrogen, but comparatively little carbon monoxide. The 300 cfm exhaust rate has been found adequate on the few installations we have observed.

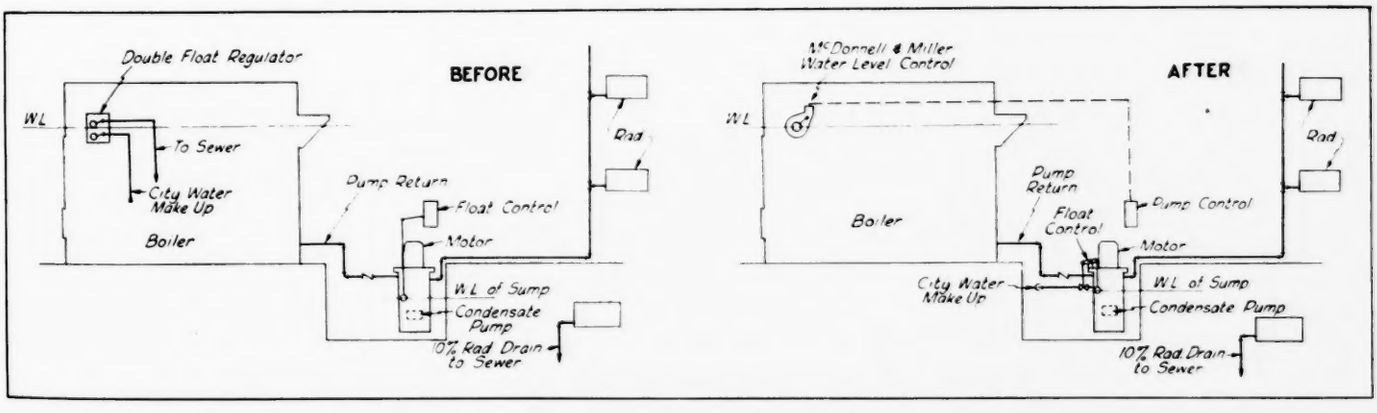
Friction losses through flexible ducts have been found to vary considerably for various types of metal and rubber ducts. Estimates of friction loss have ranged from 1.2 to two times the friction loss in a smooth duct. The higher friction loss factor for this type of installation is recommended, inasmuch as rough usage, such as kinking, bending, and denting of the duct is common in service garages, and tends to increase friction losses. Flexible ducts smaller than the above recommended sizes give very high friction losses, as shown in Table 2, requiring additional horsepower and sometimes fans with high pressure characteristics. There is a great variance in the degree of flexibility of different flexible ducts; obviously, the greater the flexibility of the duct, the easier it will be to manipulate, handle and connect.

On systems below the floor, it is well to slope the main duct slightly so that the water will drain through the duct to facilitate cleaning by flushing with water. Most municipalities have regulations which do not permit the draining of these systems directly into the sewers. Where such regulations are in effect, sumps should be provided, into which the water may drain.

We have seen expensive floor systems abandoned because of clogging, as the result of failure to provide a method of cleaning. Floor openings should be capped when they are not in use to prevent dirt and small objects from falling into the hole and clogging the duct. The caps can be screw type or spring cap type, as shown in Fig. 3 and 4.

On overhead systems, it is well to provide the flexible ducts with cables, pulleys and counter weights so that the duct can be easily drawn out of the way when not in use. The counter weights should be enclosed in a vertical box or pipe, so if a cable breaks, the weight will not fall on a worker. The life of a flexible duct can be greatly increased if a ball joint is provided at the junction of the flexible duct and the main duct.

Condensate Return System Modernized



Condensate return system control before and after changes.

A redesigned and reconditioned condensate return system was recently installed in a New York City-owned plant to correct a condition that stemmed from inability to purchase replacement parts for the regulator.

The original system, as shown on the accompanying drawing, included a double-float regulator and two float-controlled condensate pumps placed in a pit below the boiler room floor. Condensate from several radiators below the pumps was wasted to sewer, thus calling for city water make-up during non-return periods. Furthermore, varying amounts of boiler water were also wasted as the result of uncontrolled condensate return.

The rearranged return system comprises a water level regulator, the original pumps and two newly-purchased city water supply float valves.—*Francis C. Holbrook.*

THE SALES ENGINEER

Advertising and The Sales Engineer

BERNARD LESTER
Sales Engineering Consultant

ADVERTISING in trade and technical journals and by direct mail, has become almost indispensable to a complete selling job.

Good advertising informs. It gives facts of customer interest. It establishes character for the featured equipment, and shows its use. It specifically interprets apparatus merits into dollar results. It molds the opinion of prospect and purchaser, and finally helps to focus his choice and actuate his decision. In a peculiar way it reaches out and enlarges sales effort. It is both supplementary and complementary to selling.

But advertising seldom sells aparatus. This is the job for the sales engineer. He must direct his selling effort in an individual way, based on circumstance and prospect.

The great difficulty—and this is true in connection with the sale of air-handling and air-treating equipment—is that the sales engineer inclines to look on his company's advertising objectively and not subjectively. In his opinion advertising is the complete job for his principal—the company he represents—to do. He is often not particularly interested in its character or use.

Few sales engineers fully appreciate how intimately advertising can be brought into everyday sales effort. If the sales engineer fails to *contribute* to his company's advertising, he fails to grasp an important opportunity to help create and shape a very effective tool for selling. Again, if the sales engineer fails to *use* advertising, he misses another opportunity that will help him carve out valuable orders.

Contribute to Good Advertising

In considering his contribution to the creation of good advertising, don't let us get the impression that the sales engineer should be skilled in writing advertising copy. Not one in a thousand can write a good advertisement. However, every sales engineer can help to make every advertisement an effective one, because he continually deals with the intimate needs of customers and their specific problems. Who is in a better position to visualize and understand what customer's interests are? Who has a better opportunity to note their reactions? He continually observes their needs, listens to their questions, sees opinions formed, and decisions arrived at. Above all, he is the one who can spot interesting and useful results from apparatus sold and installations made. Therefore the sales engineer can be of the greatest help in creating those ideas that serve as the foundation and framework of any good advertisement.

One reason why the sales engineer is often weak in setting down and passing on material that can be used to shape good advertising is the fact that, like many of us, he is too close to the job. He is not conscious of the promotional value in what he sees and hears each day in his contact with customers. He fails to see the drama in everyday events.

Often too, the advertising manager of his company does not continually keep after him for ideas and experiences which have advertising value. A close tie-in between advertising man and sales engineer is often lacking.

Cultivate the habit of being alert to advertising possibilities. Spot the advertising value of specific customer problems and experiences met daily in contact with customers and plants. Make a short note, after an interview, which deals with the problem and its solution. Place these in the hands of your advertising man. He is the one who can mold them into a message that will interest, appeal and convince. You, as a sales engineer, made him more useful in helping you sell.

Another advantage to the sales engineer becoming advertising conscious, is the fact that this interest helps him in becoming more sensitive and alert to sales opportunities and sales appeal.

Use Good Advertising

The sales engineer can use current advertising in trade and technical papers in three ways:

First, reading such advertising will help keep him informed and alive in selling points. This applies not only to his own product, but also to the products and services of his competitors.

Second, he can point to advertising copy—either a single advertisement or a series—to impress his prospect with the standing of his company and the selling points of his apparatus. This carries weight and importance to the story he tells.

Third, he can, at the right time, display and pass on to the prospect reprints of advertisements. In doing this, he focuses the attention and interest of the prospect, and gives color and conviction to his own arguments. A particular piece of literature illustrating construction features or operating results can often be presented as a further proof of statements made.

Experience is my Classroom

By T. W. REYNOLDS

COVERING UP

Nobody likes to see the angles on duct work exposed, but if the angles are 1½ in. in some cases and the covering is specified as 1 in., the angles are certainly going to be seen wherever the ducts are run exposed. Why not specify the covering and angles to be of the same depth, but in no case with a covering less than 1 in. thick?

A DRY ACCOUNT

There is a tendency during construction to operate the heating system before it is fully complete or equipped with controls. Overheating results and where this occurs in an office section of low latent heat gain, no humidification and sub-zero temperatures outdoors, there possibly could be some extreme drying out of partitions and furniture.

In just such a case, the baseplates at partitions warped in places away from the partitions. The baseplate is of a different material from the partition and came in dry, while the building as a whole was still moist from construction.

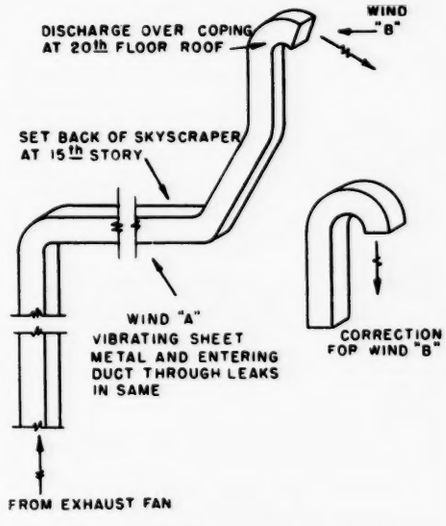
OUTDOOR DUCTS

We often get the same old problem to solve over and over again though it may sometimes be disguised by the nature of its setting. It is a relief, therefore, when considering cause, effect and remedy that the cause and remedy are of precedental nature.

Putting the end of the story first, referring to the illustration, takes all of the mystery out of a complicated problem. As the engineer of the building said at the time, "The so'ution of the problem is over our head." So it was, away up on the roof. Constant flexing of thinly clad duct sides by wind *A*, combined with accumulating soot, had cracked the metal where corroded and let the wind inside the duct. Once inside, the wind tended to go down the duct to oppose the discharge from the exhaust fan and definitely did go up the duct to exit through the gooseneck on the rear leeward side. The wind just took over the full area of the duct to the exclusion of the fan discharge.

Too much reliance is often placed on the effectiveness of vent ducts because of natural flue effect where such ducts handle heated air. Make a few computations of heat losses for high and long exterior ducts, or take a few temperature readings in such ducts, and one will often be surprised to find that an exhaust fan is handling the great weight of gases cooled approximately to outside temperature. It should also be kept in mind that in starting up the fan the air in the duct will all be cold. Inside flues are another matter. In such, a small fan may actually run backward due to the great flue effect, while in others of theoretical under-size for oil burners, the draft may have to be checked somewhat.

When you start to explore a problem such as the one illustrated, you are down in a basement where the static pressure reading at the fan is very high with wind *A*, but is all right on very warm days or when the wind dies down. You assume, therefore, that wind *A* has something to do with failure of the fan to deliver, then find that a shift of wind to wind *B* is about as bad, and thus for awhile you are a bit confused. Before this passes, you become even more confused because of the fact that during the time the fan is doing the least in exhaust from the basement, as with wind *A*, the discharge at the gooseneck is of the highest order.


DISCHARGE OVER COPING AT 20th FLOOR ROOF
WIND "B"
SET BACK OF SKYSCRAPER AT 15th STORY
WIND "A" VIBRATING SHEET METAL AND ENTERING DUCT THROUGH LEAKS IN SAME
CORRECTION FOR WIND "B"
FROM EXHAUST FAN

A skyscraper vent duct which worked backward.

Should a fan push or pull the air to be vented from a space? That is the question. Pushing the air out means that the fan can be down where it is more readily available and any leak in the discharge duct will not affect venting conditions. Pulling the air by a fan on the roof means that any fan noise will be less noticeable, that less valuable space will be taken up, and that any nuisance from odors will be avoided should the ducts leak, though it also means that no useful work will be done under the last named condition.

Obviously, one should use heavier sheet metal for exterior duct construction. Furthermore, why not use a gooseneck discharge as shown in the correction? Why expend money for equipment and power to oppose wind, such as *B* as we commonly do, because of the way most exhaust ducts are terminated.

Smoke stacks and vent ducts of metal up our buildings and over our roofs are an eyesore and a nuisance in many ways.

One looks out from one's hotel window in Florida to observe nearby hotel and notes the great height of structural steel embracing the ducts so as to keep them at home during hurricanes. Contractors who bid on Florida jobs should keep in mind the additional items of cost for protection of ducts and cooling towers against the extreme in wind exposure.

From a hotel window in Minnesota, the writer observed a long horizontal duct with sagging top collecting soot and dust—a good combination for the sheet metal business. A duct arranged so as to shed the moisture from the top would have been cheaper in the long run.

In New York, near the writer's office, a portion of a vertical stack was removed at a pair of flanges. The flanges collect soot, which with rain forms acid to attack the metal.

ENERGY MAKES WORK

Why does an engineer always seem to work harder and longer the older he gets with but little time for the things he has hoped to do some day? The more efficient he becomes with time, the more he takes on, and the more mechanical improvements there are, the more horsepower he exerts in a day's work. The telephone must be answered, the elevator brings up the callers, while the airplane brings the mail and increases his radius of operation to jobs which were once too far away. Strangely enough, however, when he was younger he was too busy to do many things, now he may be ever so busy yet find time to add one more task.

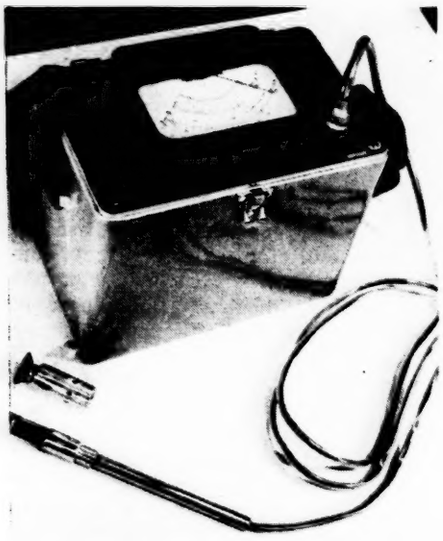
Note: Mr. Reynolds is Chief, Air Conditioning Division, Abbott, Merkt & Co., Engineers, New York.

NEWS OF EQUIPMENT AND MATERIALS

Air Meter

NAME—Anemotherm.

PURPOSE—Instrument for measuring air velocity, air temperature and static pressure.



FEATURES—Instrument operates on self-contained batteries. It measures air velocity from 10 to 5000 fpm. Temperature reading range is from 30 to 155F while pressures of .05 to 10 in. positive, .05 to 4 in. negative, may be read by this instrument. Unit consists of the probe and the case which contains the indicator, batteries, voltage regulating elements, and switches.

OPERATION—When air passes over the probe, it cools the heated wire thereby changing its resistance. The electrical balance of the bridge circuit is altered which causes a deflection of the instrument pointer. Temperature measurements are made by disconnecting the heater wire. The unheated wire acts as a temperature - sensitive resistance which is calibrated directly in degrees F. An orifice in the protection cap of the probe permits air to enter under pressure, pass over the resistance wires, and leave through exit vents. The tip of the cap is inserted in a duct so that the static air pressure is converted into air velocity in the probe to provide static air pressure reading on the instrument scale.

MADE BY—*Anemostat Corporation of America, 10 E. 39th St., New York 16, N. Y.* **295**

Unit Heater

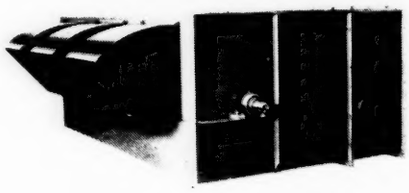
NAME—Recircul Air.

PURPOSE—Space heating.

FEATURES—Coils are copper tube with aluminum fins, of one or two-row design as specified. Additional coil sections for higher temperatures can be added to standard combinations. Cases are 14-gage, black iron welded with access panels for removing the coils through end of case. Coil sections can be mounted horizontal or vertical. Fresh air and recirculating damper can be furnished with hand quadrant or extended rod for automatic control. Standard open drip-proof ball-bearing motor operating at 1750 rpm is used. Double width blower wheels are statically and dynamically balanced.

LITERATURE AVAILABLE — Bulletin 483

SIZES AND CAPACITIES—Two basic



series ranging in capacity from 1800 to 20,000 cfm.

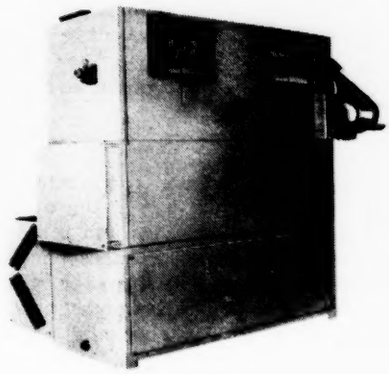
MADE BY—*The New York Blower Co., 32nd and Shields Ave., Chicago 16, Ill.* **296**

Air Conditioner

NAME—Frigidaire central system air conditioner.

PURPOSE—Space cooling.

FEATURES—Central type unit is built for matched operation with Frigidaire compressors and refrigerant control valves. Quiet slow-speed fans operate below the critical speeds to reduce vibration. Multiblade forward - curved fans have double inlets and double width wheels with mounts in oil lubricated sleeve bearings. The fan section may be installed to discharge conditioned air in various directions to meet individual conditions. Belts, pulleys, motor and fan bearings are located outside the fan section for convenient accessibility. Conditioners are provided with 2-in. viscous filters of the throw-away type and space is



provided for two additional 2-in. filters where conditions warrant. For winter operation, heating coils are available, equipped with dual speed distribution tubes to provide uniform air temperature over the entire coil face. A humidifier assembly can be placed in the fan section. Face and bypass temperatures may be added to control the temperature of air leaving the conditioner. These pumps are operated automatically by a motor with a connecting linkage located inside the fan section.

SIZES AND CAPACITIES—Eight new units with refrigerating capacities from 5 to 40 tons and capable of circulating from 2,400 to 9,000 cfm.

MADE BY — *Frigidaire Division, General Motors Corp., Dayton 1, Ohio.* **297**

Solder

NAME—No. 50 solder alloy.

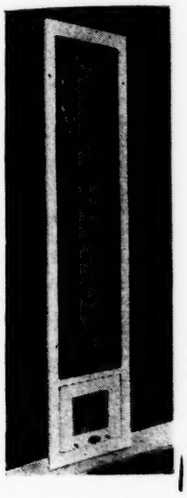
PURPOSE—To provide a solder with a melting point midway between that of tin lead solders and brazing alloys.

FEATURES—This indium-lead alloy contains no tin and melts at 600F. Makers claim very high degree of ductility and high holding strength. Alloy is available in standard wire gages as well as in ribbon form.

MADE BY — *Soldering Specialties, Summit, N. J.* **298**

Wall Heater

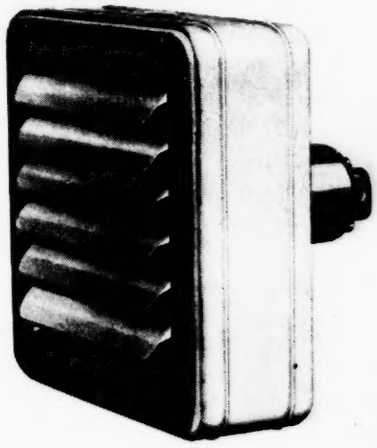
NAME—Pion-Aire wall heater.
PURPOSE—Space heating.



FEATURES — Unit can be installed in any wall of standard 2 x 4 in. stud construction. It fits flat against the wall and does not require any cutting of floors. Unit operates on natural or manufactured gas and is provided with an automatic safety dial to shut off the fuel supply if the pilot light goes out. Baffled flues are used to conserve the rising heat and a reflector is placed behind the flues for more effective radiation.
SIZES AND CAPACITIES—No. 10 for 10,000 Btu input and No. 20 for 20,000 Btu input. A third model, 30,000 Btu input will soon be available.
MADE BY—*Pioneer Water Heater Corp., Los Angeles, Calif.*.....**299**

Unit Heater

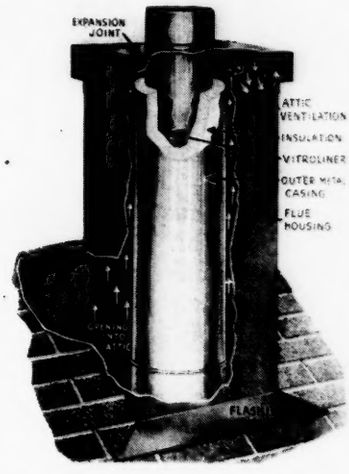
NAME—Trane Model H unit heater.
PURPOSE—Space heating.
FEATURES — All non-functional parts such as ornaments have been



eliminated. The casing is in three parts with top, bottom and sides of one piece construction. A fan shroud and louvers complete the casing assembly. Casing can be opened for inspection. Coil is protected against rapid temperature change expansions and contractions by a floating coil feature. Heater is bonderized to make it rustproof. Unit is provided with a non-freeze coil.
SIZES AND CAPACITIES — Available in 24 different sizes with capacities from 20,000 to 352,000 Btu.
MADE BY—*The Trane Company, La Crosse, Wis.* **300**

Chimney

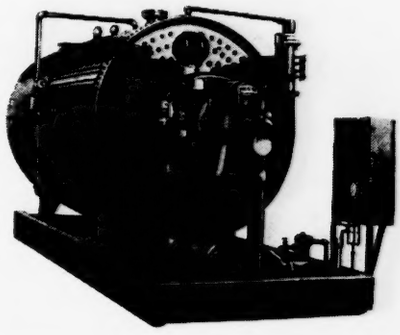
NAME—Vitroliner Type E flue.
PURPOSE—To provide prefabricated light-weight flue.
FEATURES — Designed for home heating equipment, it is supported entirely from the ceiling and roof and does not require any brick work. Central flue pipe is a porcelain enameled metal liner. Be-



tween this liner and an outer metal casing is placed asbestos insulation.
MADE BY—*Condensation Engineering Corp., 122 So. Michigan Ave., Chicago 3, Ill.* **301**

Steam Boiler Unit

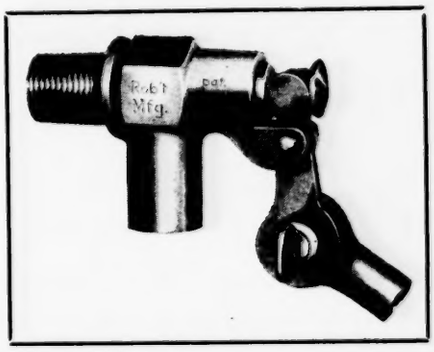
NAME—Johnston steam boiler unit.
PURPOSE—Steam generation.
FEATURES—Packaged steam boiler unit is a Scotch type horizontal, internally fired, three-pass firetube boiler. Burner is designed for heavy oils and is equipped with gas-electric ignition electric preheater, built-in pump, full modulating fire, and the necessary controls for completely automatic operation. Boiler is regularly fur-



nished with 100, 125, 150, and 200 lbs working steam pressures. The water spaces surrounding the combustion chamber are utilized to accelerate circulation and to provide quicker steaming. Boiler is of welded construction built according to the ASME code for low pressure boilers.
LITERATURE AVAILABLE — Bulletin No. 503.
MADE BY—*Johnston Brothers, Inc., Ferrysburg, Mich.* **302**

Float Valve

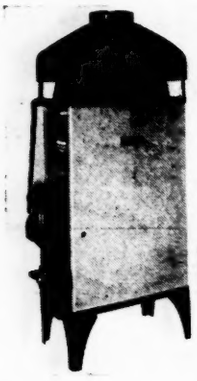
NAME—Bob float valve.
PURPOSE — To maintain desired water level in evaporative coolers.
FEATURES—Valves have ratcheted actuating lever that maintains the water at any level for which the device is set. Valve plunger is equipped with replaceable soft rubber disk and leather cup-leather. Valve is available either for mounting above the water lever or for submerged operation where it is to be used under corrosive conditions.
MADE BY—*Robert Manufacturing Co., 4004 W. Jefferson Boulevard, Los Angeles 16, Calif.* **303**



Heater

NAME—Watrola.

PURPOSE—Generation of hot water for radiant heating systems or domestic hot water for hotels, restaurants, and commercial uses.



FEATURES — Unit consists of the core in which heat is transferred to the circulating water; the combustion chamber; and the controls. Core consists of ⅝ in. copper tubing wrapped around sheet copper pre-heater shell. The tubing is connected with the heat transfer section composed of fin and tube construction. Entire core is tinned for better heat transfer. Four water passages through core are said to reduce pressure drop. A powerstat makes it impossible to open the main gas valve without first lighting the pilot. Failure of the pilot flame results in closing the main gas valve. Protection is provided against overheating.

SIZES AND CAPACITIES—Measures 47 x 10 x 22½ in. Heat output is 120,000 Btu per hr. It delivers 240 gph of water raised 60F.

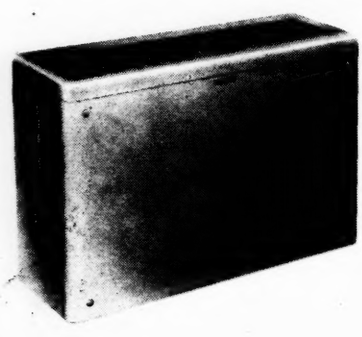
MADE BY—*George E. Swett & Co., 256 Mission St., San Francisco, Calif.* **304**

Cabinet Heater

NAME—Young cabinet heater.

PURPOSE—Space heating.

FEATURES—New line of cabinet heaters consists of three models with three sizes in each style. Style *A* is the basic unit, style *B* the universal unit, and style *C*, semi-recessed unit. Style *A* is illustrated. Tubes and fins are non-ferrous with tubes rolled into gray-iron castings. Rolled-in tube joints are said to insure low pressure drop. Knockouts are located in the ends of cabinet to permit connections to be made directly through the sides. Coil can be pitched in either direction. Blower assembly may be removed as a single unit.



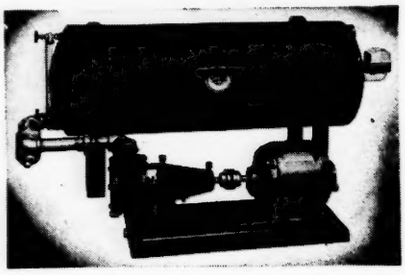
LITERATURE AVAILABLE — Catalog No. 6548.

MADE BY—*Young Radiator Co., Racine, Wis.* **305**

Condensate Return

NAME — Roth condensate return unit.

PURPOSE—For use with steam plants in office buildings and industrial establishments using steam process equipment.



FEATURES—Unit consists of a turbine pump, electric motor, strainer, float switch or make-up valve, and a steel receiver. It is designed to handle pressures up to 150 lb and radiation up to 35,000 sq ft. Makers claim that it will handle hot condensate at high pressures without vapor binding or water hammering. Model is also available as Duplex unit with two pumps, so that one pump can be available as stand-by protection.

MADE BY—*Roy E. Roth Co., Rock Island, Ill.* **306**

Boiler

NAME—No. 1500 Smith-Mills residential boiler.

PURPOSE—Space heating.

FEATURES—Hot gases from oil combustion pass upward over vertical water tubes and laterally in the proper channels through which they are drawn to the front of the boiler. These gases return the entire length of the boiler to the lower side flues before passing into the chimney. The boiler has a built-in automatic hot water heating coil.

Boiler comes in both steam and hot water models.

SIZES AND CAPACITIES—I-B-R ratings are 84,000, 102,000, 120,000 and 138,000 Btu.

LITERATURE AVAILABLE—Illustrated folder.

MADE BY—*The H. B. Smith Co., Inc., Westfield, Mass.* **307**

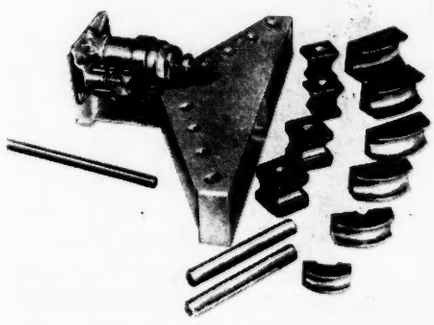
Pipe Bender

NAME—Lightweight Champ.

PURPOSE—Portable pipe bender.

FEATURES—Combined weight of 30-in. steel welded frame and hydraulic jack is 83 lb. Unit has open body construction to speed up production of pipe bending. Hydraulic jack can be removed from frame in case it is to be used for other functions. Unit comes complete with ¾, 1, 1½, 2 and 2½ in. dies.

MADE BY—*Electric Cord Co., 30 Church St., New York 7, N. Y.*...**308**



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IS IDEAL FOR SOIL, WASTE AND VENT LINES

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Experience has proved that Revere Copper Water Tube is the ideal material for drainage and vent systems because:

1. *It is highly resistant to corrosion, which assures a longer life for the system.*
2. *Its permanently smooth interior surfaces provide free, unobstructed flow.*
3. *Joints made with solder fittings are economical in time and materials.*

In drainage systems—just as in heating, water supply and air conditioning—*trouble always costs more than Revere Copper Water Tube.* Each length of this tube is stamped at regular intervals with the Revere name and the type. These marks are more than identification—they are your assurance of full wall thickness and the close O. D. dimensional tolerances so essential for tight soldered joints.

You can specify or install, in addition to Revere Copper Water Tube, such other long-lived materials as Red-Brass Pipe; Sheet Copper and Herculoy for tanks, ducts, pans and trays; Dryseal Copper and Aluminum Refrigeration Tube (dehydrated and sealed); Copper oil burner, heat control and capillary tubes. The Revere Technical Advisory Service is always ready to serve you. Call your Revere Distributor.

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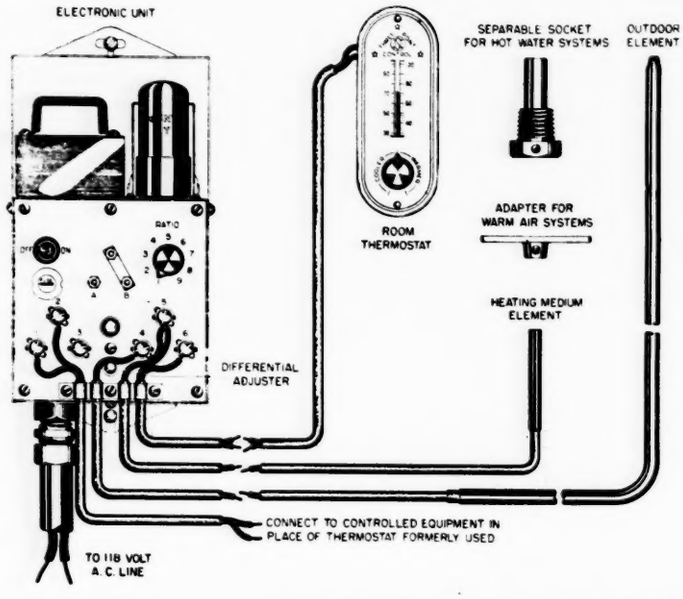
Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere.

Temperature Control

NAME—Johnson three-point controller.

PURPOSE—For use with hot water or warm air heating systems, to maintain comfortable room temperatures in homes and small buildings in accordance with outdoor prevailing weather conditions.


ELECTRONIC UNIT
SEPARABLE SOCKET FOR HOT WATER SYSTEMS
OUTDOOR ELEMENT
ROOM THERMOSTAT
ADAPTER FOR WARM AIR SYSTEMS
HEATING MEDIUM ELEMENT
DIFFERENTIAL ADJUSTER
CONNECT TO CONTROLLED EQUIPMENT IN PLACE OF THERMOSTAT FORMERLY USED
TO 118 VOLT A.C. LINE

FEATURES—Unit is an adaptation of the company's Duo-Stat control. The outdoor temperature thermostat, indoor thermostat and heating medium element are connected to an electronic control that translates the temperature measurements into controlling action whenever a temperature change takes place at any of the three control points. Manufacturers claim that this type of control results in fuel saving. With this system of control, temperature of the hot water or warm air is changed in accordance with outdoor conditions or demand for heat. An alternating signal voltage is passed through two stages of amplification and the amplified output is used to operate a single pole, single throw plate circuit relay which energizes a heating element around a bimetallic strip and operates a micro switch. Amplifier is provided with a special built-in transformer. Each electronic unit is housed in a special cabinet. With the addition of a damper operator, this system may also be used to operate hand-fired warm air or hot water heating system.

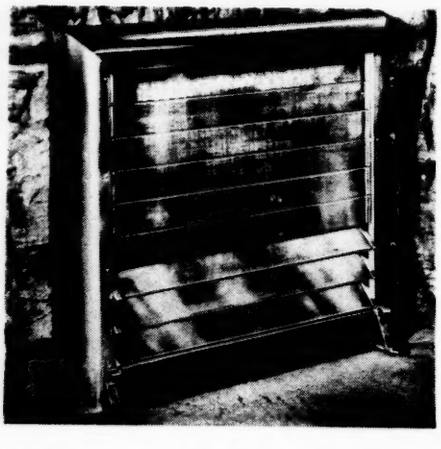
LITERATURE AVAILABLE—T-381 covering construction and installation.

MADE BY—*Johnson Service Co., Milwaukee 2, Wis.* 309

Fireplace Screen

NAME—Air-Trol.

PURPOSE—To permit proper fireplace draft control and conservation of fuel.



FEATURES—Unit has heavy glass louvers which can be adjusted at top or bottom to check or increase draft to fireplace. Louvers are operated by turning knurled knobs geared to the glass strips. A bronze mesh screen is placed back of the louvers.

SIZES AND CAPACITIES—Three standard sizes available.

LITERATURE AVAILABLE—Illustrated folder.

MADE BY—*Dollinger Corporation, Rochester, N. Y.* 310

Enamel

NAME—Lustral 67.

PURPOSE—Protective coating.

FEATURES—Synthetic enamel developed for interior use is recommended by the manufacturers for general industrial painting, product finishing, and maintenance work. It is claimed to be suitable for brushing, spraying or dipping and may be either air-dried or baked. Available in 21 colors in addition to gloss white, semi-gloss white and black.

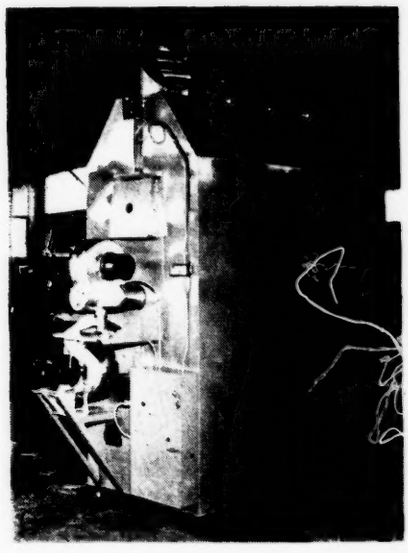
MADE BY—*The Sherwin-Williams Co., Industrial Division, Cleveland, Ohio.* 311

Heater

NAME—Olson industrial warm air heater.

PURPOSE—For space heating and ventilating of industrial buildings.

FEATURES—Unit can be operated on oil, gas or coal. Heater has a four-pass gas travel and a separate induced-draft fan. Shaft bearings are placed outside of heater for quick servicing. Unit can be adapted to filtering, humidifying or air conditioning.



SIZES AND CAPACITIES—For the gas- or oil-fired package unit, from 300,000 to 2,000,000 Btu; for the stoker-fired type, 500,000 to 2,000,000 Btu and for the central type which can be either stoker operated or can use oil or gas, capacities range from 2,500,000 to 6,000,000 Btu.

LITERATURE AVAILABLE—Catalog BE-848.

MADE BY—*Arthur A. Olson & Co., Canfield, Ohio.* 312

Egg-breaking production line where girls separate the whites from the yolks. Conditioned air here keeps dust and bacteria from contaminating the eggs.

BETTER EGGS THE YEAR AROUND with air-conditioning

Frozen eggs and powdered eggs rivalling the fresh-laid article in quality and flavor are now widely used by bakers, confectioners and manufacturers of various food products. As fresh in December as they are in May, these processed eggs are not subject to seasonal price changes like ordinary eggs in the shell.

This dramatic development in the food industry has been made by progressive produce firms who have taken full advantage of modern air-conditioning and refrigeration.

An example is the Seymour Packing Company of Topeka, Kansas. Starting out as a small produce and poultry store in 1890, this organization constantly improved its methods through research, and expanded until it became one of the nation's largest processers of eggs. During the Spring when eggs are at the peak of quality, Seymour breaks, homogenizes and freezes more than 2,000,000 per day.

Some of these are stored then sold later in the frozen form. Others are dehydrated by pumping liquid egg in a fine spray under high pressure into a heated cyclone-type drying chamber to be sold in powdered form. In these processes strict control of temperature, humidity, and air circulation are of vital importance. This control protects the flavor, guards against weight losses, and prevents spoilage of a highly-perishable food.

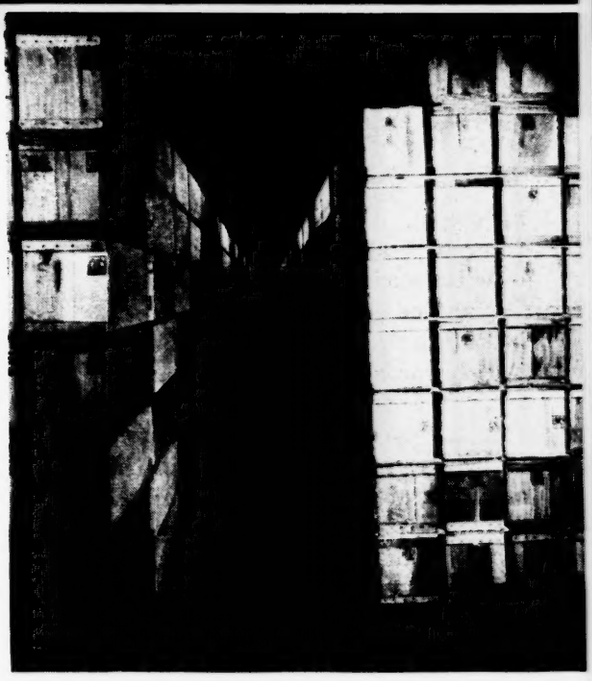
The refrigeration and air-conditioning equipment used in the Seymour plants is manufactured by the York Corporation who in turn uses high-quality Bethlehem steel sheets in many of its products. Bethlehem manufactures the full line of hot-rolled, cold-rolled, galvanized, and copper-bearing steel sheets used in the manufacture and installation of industrial air-conditioning systems.

BETHLEHEM STEEL

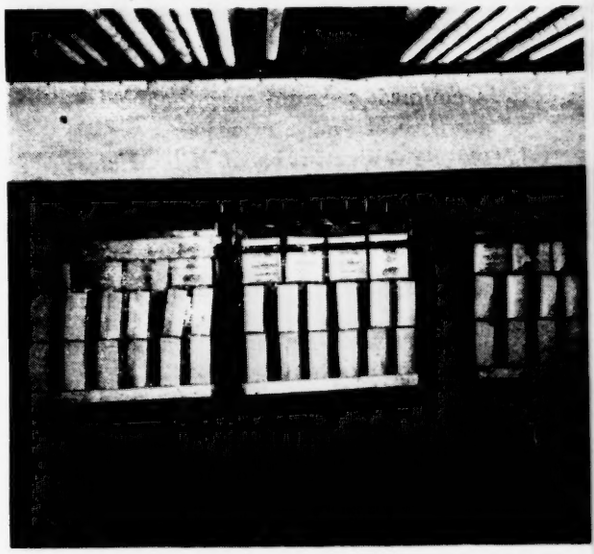
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

Export Distributor: Bethlehem Steel Export Corporation



More than 40 carloads of fresh eggs are stored here in the Seymour plant awaiting processing. Storage temperature of 31 deg with high humidity prevents these eggs from losing weight and from absorbing outside odors.



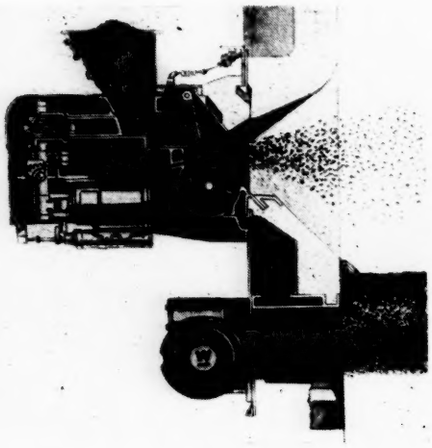
Cases of liquid eggs in a freezing tunnel. Here an air blast of 50,000 cu ft per min at 20 to 25 deg below zero freezes the eggs solid.

Stoker

NAME — Westinghouse Centrafire stoker.

PURPOSE—Spreader-type industrial stoker.

FEATURES—Coal is trajected by an



air-cooled, hydraulic motor-driven rotor so that the coal falls evenly over the entire length of the grate. Undulation of the central grate keeps the fuel bed active and moving towards the ash discharged from the furnace without interrupting the coal feed. A deficiency of primary air rising through the central grate is maintained deliberately so that resulting monoxides are burned in a turbulent secondary air supply about the trajectory of incoming fuels. An increased supply of metered primary air is admitted through the side areas of the grates and ash-discharge grates to provide complete combustion. Coal is fed to the rotor by two long-stroke, slow-speed rams. A constant speed rotor or damper supplies oil pressure for all controls and drives. Hydraulic drive, it is claimed, permits maintenance of any preset fuel-air ratio.

MADE BY—*Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa.* **313**

Greenhouse Control

NAME—Gradual Da-Nite change-over control.

PURPOSE—For maintaining selected temperature in greenhouses and for providing a gradual change-over from day to night temperatures.

FEATURES—The change-over from day to night temperature is gradual in order to prevent shock to plants. Length of change-over time can be set from 15 minutes to 7 hours. A control permits day temperatures to vary to correspond with outdoor weather conditions. A control panel consists of five separate dials, one being a 24-hour clock which sets the change-over time from day to night and night to day. Another dial indicates the main operating pressure of the pneumatic control system and another dial is used to vary the day temperature control to correspond to outside weather conditions. A special instrument indicates the control point temperature in any or all of the greenhouses and the fifth unit is a timer to vary the length of time for change-over from day to night operation.

LITERATURE AVAILABLE—Illustrated bulletin.

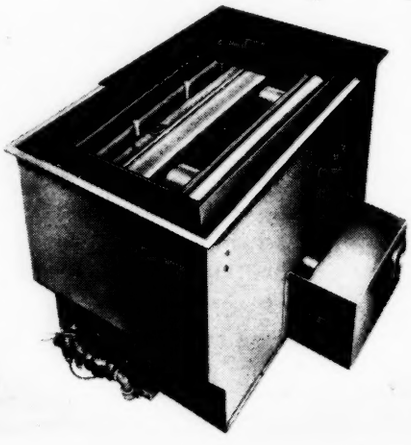
MADE BY—*Minneapolis-Honeywell Regulator Company, Minneapolis, Minn.* **314**

Floor Furnace

NAME—Temco Model 506-1 gas floor furnace.

PURPOSE—Space heating.

FEATURES—Shallow gas floor furnace measures 25½ in. overall depth. Unit is equipped with a porcelain enamel heat chamber; a ceramic port burner is incorporated to improve the efficiency and life of the unit. Unit is provided with automatic safety controls and if desired, with automatic electric temperature controls. Ceramic surface treatment of the heat chamber



is of the type developed by the National Bureau of Standards for aircraft power plants.

SIZES AND CAPACITIES—35,000, 50,000 and 70,000 Btu.

MADE BY—*Tennessee Enamel Manufacturing Company, Nashville 9, Tenn.* **315**

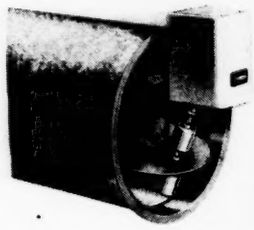
Draft Control

NAME — Sampsel sequence draft control.

PURPOSE—Improved fuel burner results through eliminating stack losses.

FEATURES—When burner shuts off, control is activated and opens the barometric regulator which provides 30 seconds for smoke to be cleared from the heating plant. With this control open, the natural draft by-passes the heating plant while the burner is off. Makers claim that stored heat is not wasted up the chimney. When the thermostat again calls for heat the control returns the barometric regulator to its normal operating position.

MADE BY—*Sampsel Time Control, Inc., Spring Valley, Ill.* **316**



Coating

NAME—Carbo-Kote.

PURPOSE—Corrosion resisting coating for tanks, hoods, etc.

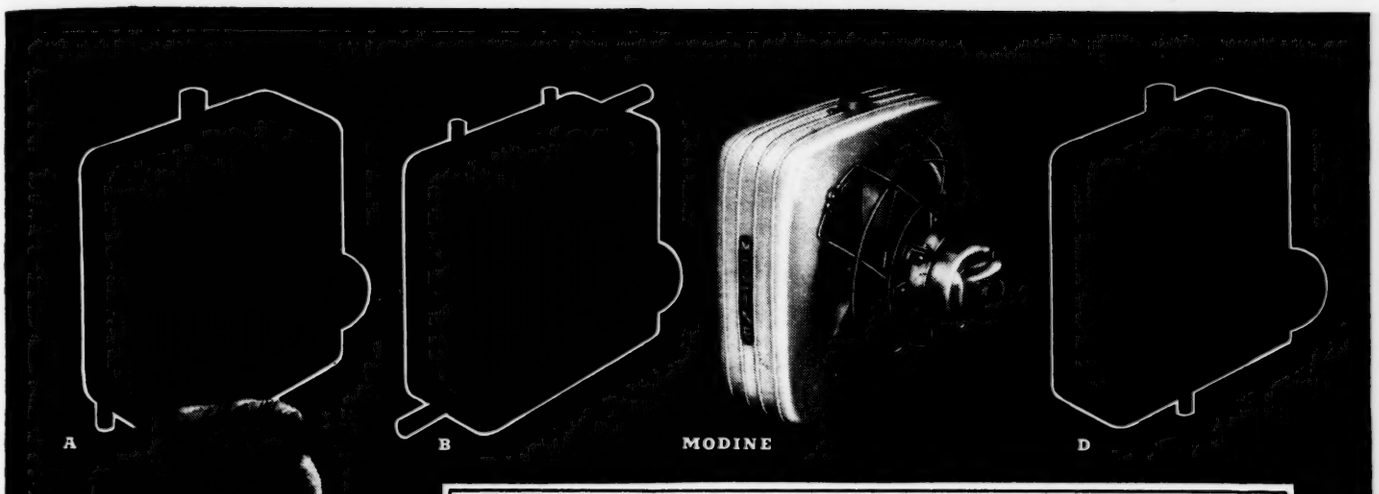
FEATURES—Coating is said to resist the action of most acids, alkalis, solvents and mixtures of such corrosives with the exception of nitric acid and sulfuric acid of over 45% concentration. Coating film after setting will flex from 10 to 15%. Makers claim that due to its viscosity, one brush coat is from 8 to 30 times the thickness of a coat of paint.

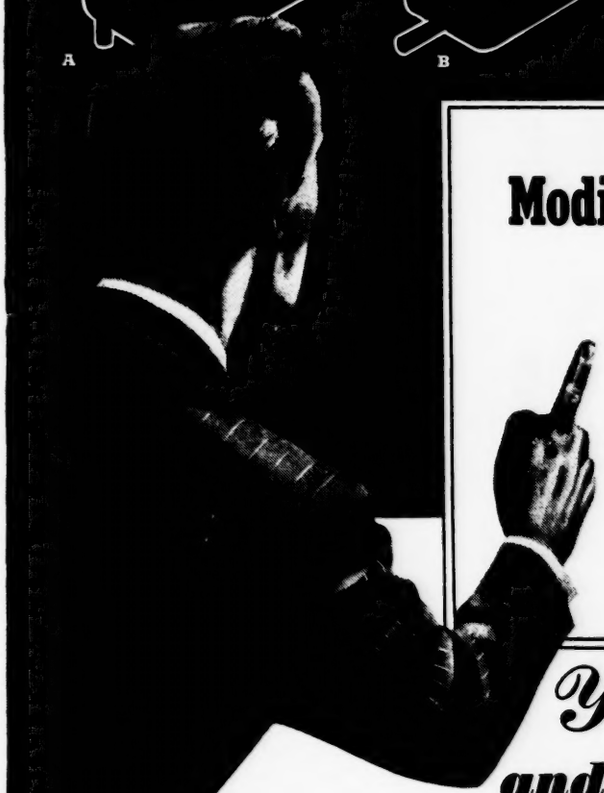
LITERATURE AVAILABLE — Bulletin M-2.

MADE BY—*Carboline Co., 502 N. Taylor St., St. Louis 8, Mo.*..... **317**

If you're ordering unit heaters, Modine says,

"Look before you buy!"





Modine makes this Special Offer!

See your Modine Representative. He'll show you an actual Modine Unit Heater and explain its features in detail. You'll like its attractive appearance, sound engineering, rugged construction. Examine Modine — compare it with other unit heaters before you decide!

Yes... look before you buy, and you'll buy Modine...

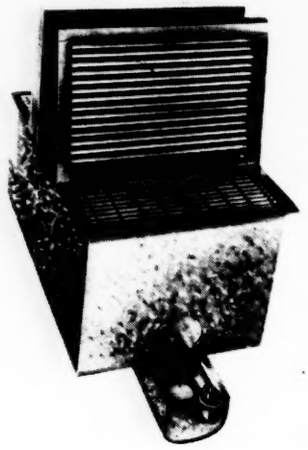
Check these important features! Remember — only Modine, THE quality unit heater, gives you ALL of them. (1) *Modern Beauty*—functional streamline design for today's and tomorrow's interiors. (2) *All-Copper Coils* — defy corrosion . . . fins are metallically bonded to tubes, tubes brazed to headers. (3) *Peak Performance*—combines uniform temperatures with precise control. (4) *Simple Installation* — easy, safe — without expensive supports or extra labor costs. (5) *Smooth Operation* — quiet, economical and good for years of heating comfort. (6) *Complete Line* — in horizontal and vertical delivery types, 47 capacities to meet varying heat, air delivery, height and location demands.

Yes, look before you buy! You'll say Modine is years ahead. Your Modine Representative will gladly give you further details — or write direct for additional information. Modine Mfg. Co., 1511 Dekoven Ave., Racine, Wis.

Modine Unit Heaters

Register

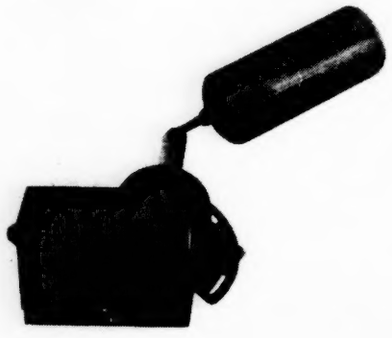
NAME—Clearflo register.
PURPOSE—Uniform heat distribution through a directional louver type register.



FEATURES—Register and casing are built as a single unit so that the entire assembly will fit either a 2 x 3 in. or 2 x 4 in. stud wall construction. Heat is directed down and out into the room. Width of floor grille flanges have been increased to cover any irregularities in flooring at the junction with a furnace casing. This type register has been developed for the Stubby floor furnace. The furnace is installed from above the floor without patching and features a watertight pan containing a burner and all controls that can be readily removed for servicing.
MADE BY—*Holly Manufacturing Co., 875 South Arroyo Parkway, Pasadena 2, Calif.* **318**

Float Switch

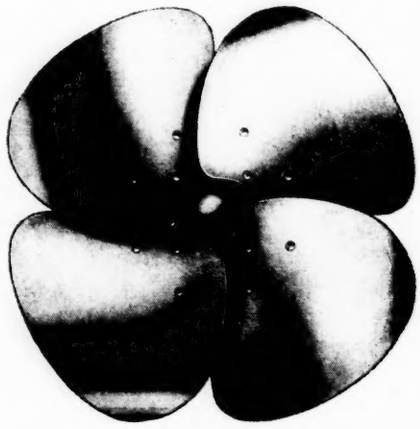
NAME—Type LC-200 closed tank float switch.
PURPOSE—Water level control.



FEATURES—Switch is housed in a welded steel case with ½ in. conduit openings on both sides. It is designed for closed tank operation with pressures up to 100 lb per sq in. and temperatures up to 200F. Shafting is stainless steel with silicone lubrication. It will serve with motors up to 2 hp on 220 volts a-c. It can be regulated so that float switch closes or opens at high level.
LITERATURE AVAILABLE — Bulletin 2050.
MADE BY—*Automatic Control Co., 1005 University Ave., St. Paul 4, Minn.* **319**

Fan Blades

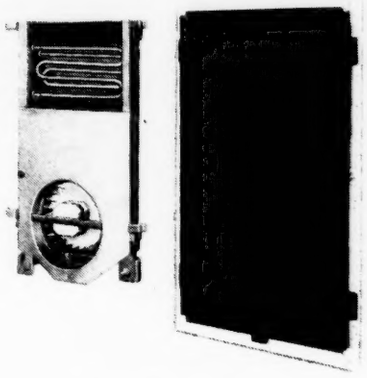
NAME—HI-Eff fan blades.
PURPOSE—Movement of air.
FEATURES—Makers claim that new type fan blade can be readily adapted for all existing space heaters and unit heaters. It is available in three-blade construction



from 10 to 20 in. in diameter and four-blade construction in diameters from 8 through 20 in. Blades are aluminum with spider and hub of steel.
LITERATURE AVAILABLE — Eight-page catalog.
MADE BY—*The Torrington Manufacturing Company, Torrington, Conn.* **320**

Wall Heater

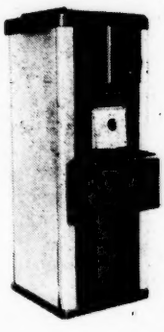
NAME—Chromalox electric recessed wall heater.
PURPOSE—Space heating.
FEATURES—Unit is provided with a built-in thermostat, pressure type fan, and electric tubular heating units. Fan can be operated independent of heater elements and heater can function at partial capacity during cool weather. Thermostat control is in operation when



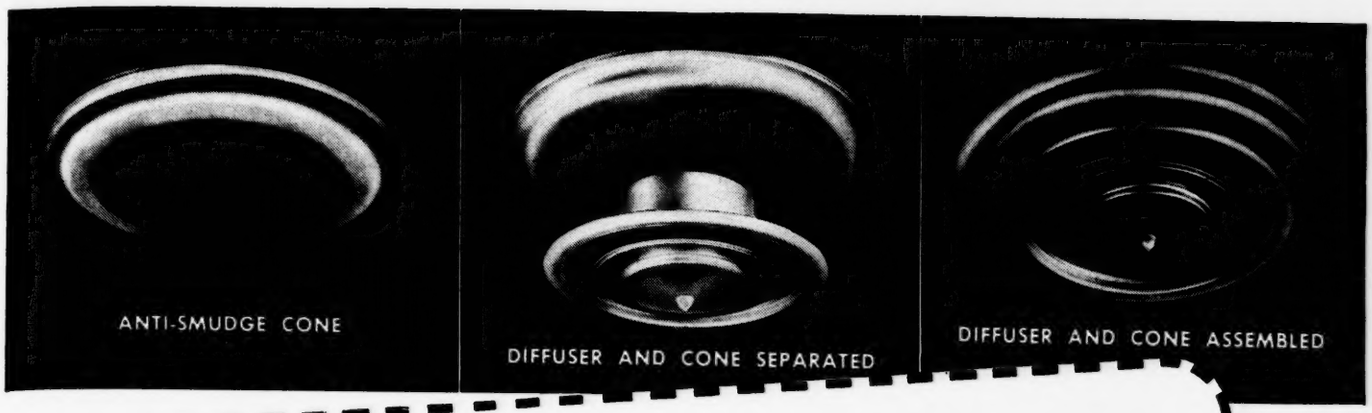
heater is operating at full capacity. Unit consists of wall box, heater assembly, and grille cover. Heater elements are placed on top of the assembly, back of the upper grille. A protective thermal cutout prevents overheating of the elements in case operation of the fan is interrupted.
SIZES AND CAPACITIES—Available in 2, 3, 4, and 5 kw for 236 volt, a-c operation.
MADE BY—*Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa.* **321**

Furnace

NAME—Armstrong steel vaporizing Hi-Boy furnace.
PURPOSE—Space heating for the smaller home.



FEATURES—Objective of design was to provide a suitable heating unit that would occupy a minimum amount of space. A vaporizing type burner is used with a stainless steel combustion chamber. Automatic humidification, forced air circulation, and filtering are provided. Blower is operated by a 1/6 hp motor.
SIZES AND CAPACITIES—72,000 Btu per hr at bonnet.
MADE BY—*Armstrong Furnace Co., Columbus 12, Ohio.* **322**



Announcing Kno-Draft Ceiling Smudge Control

Now you can control tough smudging problems. When exceptionally sooty, smoky or dusty air conditions are expected, or where rough textured, dirt-catching ceilings are employed, Kno-Draft Anti-Smudge Cones give the utmost in protection—and increase the attractiveness of the diffuser besides.

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FREE HELPFUL LITERATURE

☐ BULLETIN K-22—Contains complete details on the new and exclusive Kno-Draft Anti-Smudge Cone.

☐ NEW HANDBOOK ON AIR DIFFUSION — Contains all the engineering data necessary on air diffusion in general and Kno-Draft Adjustable Diffusers in particular to enable you to create "custom-made" air patterns and eliminate drafts.

W. B. Connor Engineering Corp.
Dept. E-106, 112 East 32nd Street
New York 16, New York

Please send me the free literature I have checked above.

Name.....

Company.....

Street.....

City..... Zone..... State.....

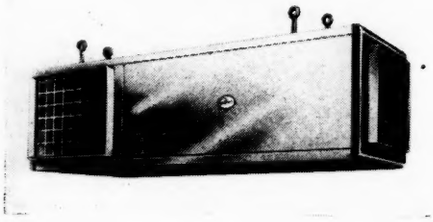
Motor Switch

NAME—G-E manual starting switch for fractional horsepower motors.
PURPOSE—Manual operation of small motors.

FEATURES—Switches are furnished in five types—general-purpose enclosure; without enclosure; combination unit and selector switch; with cast iron enclosures for wet locations, and a similar type for dusty or hazardous locations. All types have a molded base of moisture-resisting insulating material. Switch handle moves to the off position on over-load thereby giving positive indication that the power is shut off. A wheel-type movable contact cleans as it rolls against the stationary contacts and recedes into a recess in the base to effectively snuff the arc.
MADE BY—*General Electric Co., Schenectady 5, N. Y.* **323**

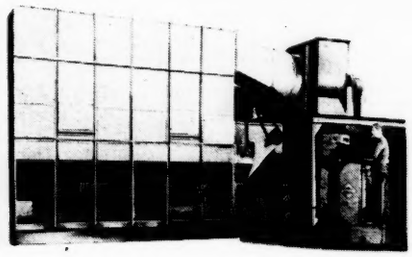
Furnace

NAME—Model GSU1 oil-fired suspended furnace.
PURPOSE—Space Heating.
FEATURES—Unit is suspended from the ceiling by four steel eye-bolt hangers. Air to be heated is drawn through two large filters by a blower and forced over the heating unit. Furnace has a stainless steel combustion chamber with an inner liner of galvanized steel. The double-inlet centrifugal type blower is dynamically balanced. A two-stage pumping unit handles high oil lifts. Burner and controls are mounted on the rear of the unit for easy accessibility.
SIZES AND CAPACITIES — 100,000 Btu per hour at outlet. Blower capacity, 750-1150 cfm. Motor, ¼ hp.
MADE BY—*Gilbert & Barker Mfg. Co., West Springfield, Mass.*.....**324**



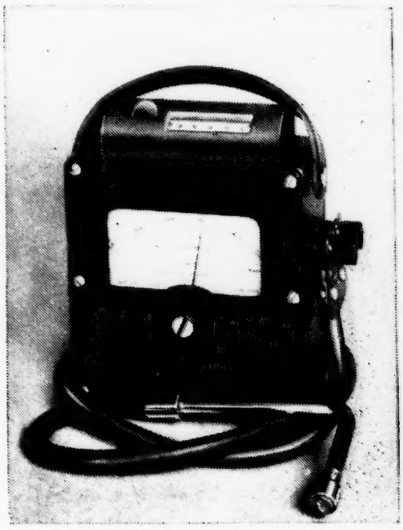
Dust Collector

NAME—Centri-Merge swirl type dust collector.
PURPOSE—Removal of dust and dirt from shakeout stations in foundries and sand handling and conditioning systems.
FEATURES—The unit is of all stainless steel construction to provide a maximum possible rate. Sludge disposal is by means of a skid on a lift truck. The conveyor drive is located on top of the conveyor spout. Makers claim that because of compact design that the unit occupies a minimum amount of floor space.
MADE BY — *Schmieg Industries, Inc., Detroit, Mich.* **325**



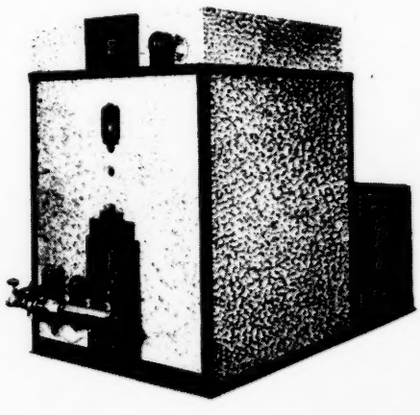
Pyrometer

NAME—Alnor Type 500 pyrometer.
PURPOSE — Temperature measurement from 0 to 150F.
FEATURES—Instrument is provided with a manual cold end adjuster and adjustment can be made by holding thermocouple against an aluminum test block and turning the cold end adjuster screw until the pyrometer reading duplicates the indications of the thermometer. Instruments are designed for checking surface temperatures of panels in panel heating and cooling installations.
MADE BY—*Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago 10, Ill.* **326**



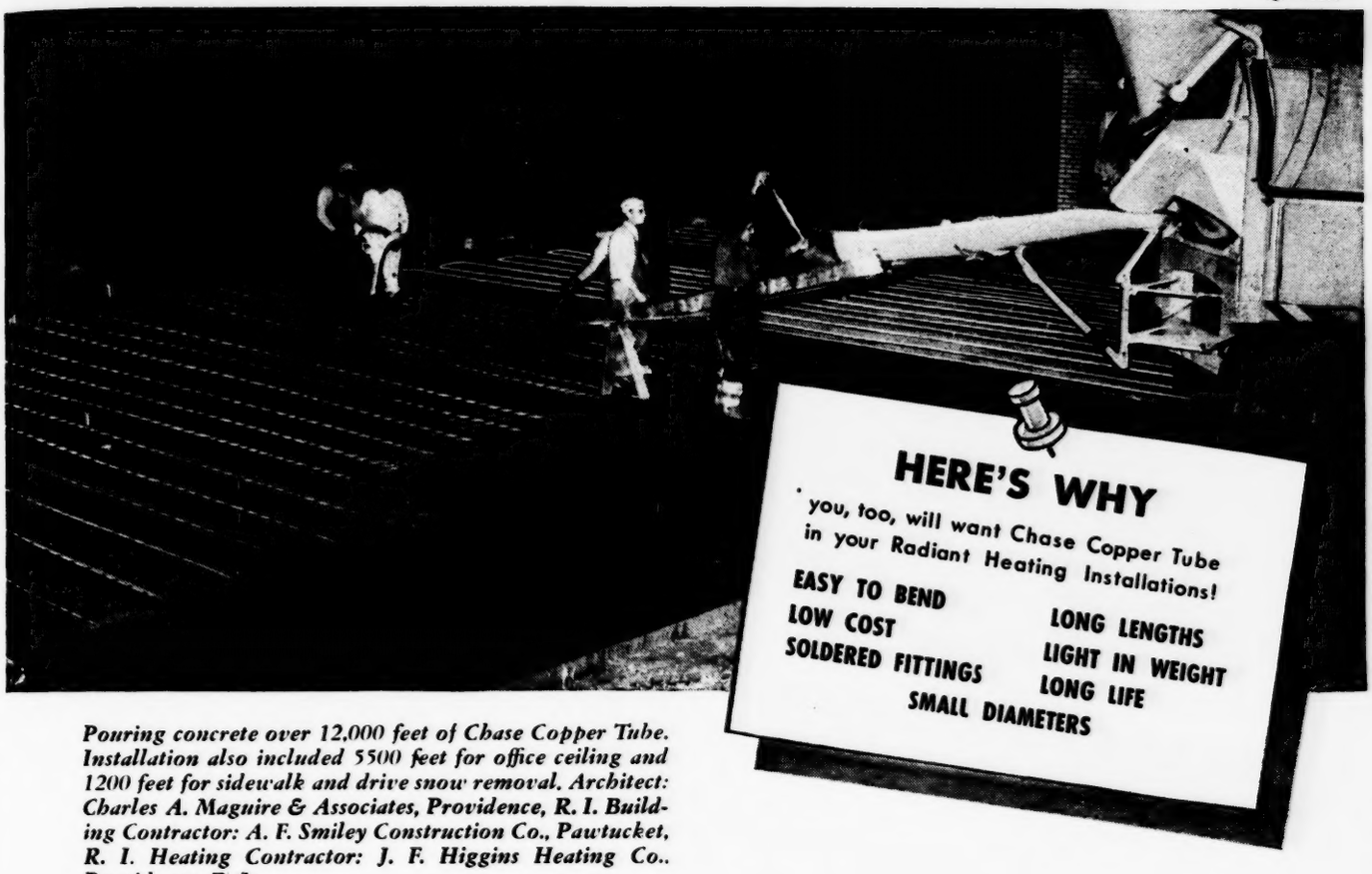
Furnace

NAME—Janitrol winter air conditioner.
PURPOSE—Warm air space heating.
FEATURES—Improved design of unit includes a redesigned burner chassis which is easily removable. Each ribbon burner releases as a complete unit. A top plate flue collector permits cleaning of the heat exchanger tubes. This unit has a new type plug-in self positioning pilot, cushioned suspension of the floor assembly, and a cabinet which encloses all controls and parts.
SIZES AND CAPACITIES—Six sizes ranging from 60,000 to 180,000 Btu per hr input rating.
MADE BY — *Surface Combustion Corp., Columbus, Ohio.* **327**



PROVIDENCE WAREHOUSE WITH 22,000 SQ. FT. FLOOR AREA USES CHASE COPPER TUBE FOR RADIANT HEATING!

CHASE



Pouring concrete over 12,000 feet of Chase Copper Tube. Installation also included 5500 feet for office ceiling and 1200 feet for sidewalk and drive snow removal. Architect: Charles A. Maguire & Associates, Providence, R. I. Building Contractor: A. F. Smiley Construction Co., Pawtucket, R. I. Heating Contractor: J. F. Higgins Heating Co., Providence, R. I.

BIG jobs . . . little jobs, Chase Copper Tube has the advantages that mean fast, economical installation . . . dependability! For instance: you reduce costly, time-consuming connections because Chase Copper Tube is available in coils up to 100 feet long. Its flexibility means quick, easy hand-bending! And no fittings are needed at bends.

In floor installations, as illustrated, there's no need for accurate leveling of Chase Copper Tube. For ceilings, its light weight makes this overhead work easier . . . and its small diameter does not require extra plaster for coverage. Send for instructive, informative booklet that discusses radiant heating in theory and practice. Write Dept. HV-108.

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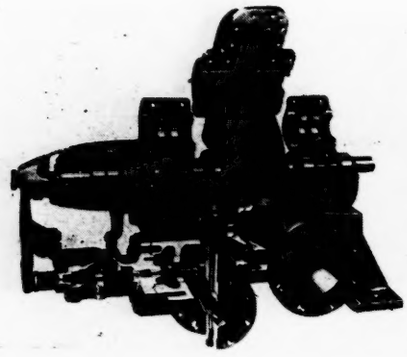
Turbine

NAME—Westinghouse Typee turbine.

PURPOSE—Turbine for driving pumps, fans, blowers and compressors.



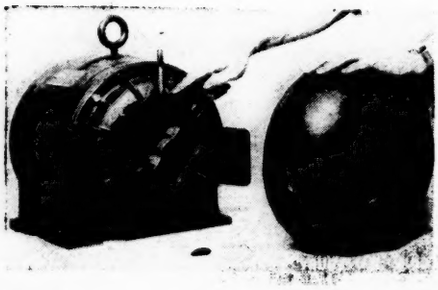
FEATURES—A combination of felt and labyrinth bearing seals protect the turbine's lubricating system from contamination. Corrosion resistant materials are used throughout the construction of this unit. Over-speed trip simultaneously closes the governor valve and a heavy butterfly valve at a predetermined speed. The basic turbine is provided with a shaft type governor mounted in a rugged casing that protects the governor assembly and shaft end. The entire governor assembly can be replaced without disturbing the shaft.

SIZES AND CAPACITIES—Wheel sizes of 16, 20 and 25 in. to be applied over a range of 5 to 1500 horsepower with steam conditions up to 600 lbs gage at 750F and speeds of 1,000 to 7,000 rpm. Equipped with heavy-duty parts, turbine wheel operates at 1,500 lbs at 950F.

MADE BY—*Westinghouse Electric Corp., Pittsburgh 30, Pa.*.....**328**

Motor

NAME—G-E Tri-Clad totally enclosed fan-cooled motor.



PURPOSE—Totally enclosed corrosion-resistant cast iron motor for use in corrosive atmospheres.

FEATURES—Motor has a newly developed corrosion-resistant Textolite cooling fan. Fan is non-sparking and while it is claimed to have the features of metal fans, it is said to be relatively inert to most corrosive atmospheres. A web on the inner face of the hub serves as a barrier to prevent liquids from passing directly through the fan and coming in contact with the bearing seal. Motor is said to be highly corrosion-resistant.

SIZES AND CAPACITIES—1 to 20 hp.

MADE BY—*General Electric Co., Schenectady 5, N. Y.* **329**

Valve

NAME—Sweatflow control valve.

PURPOSE—Valve for use with direct sweat connections with copper tube installations in hot water circulating systems.

FEATURES—External and internal parts are bronze with the valve precision tooled for accurate seating.

SIZES AND CAPACITIES—1, 1¼, 1½ and 2 in.

MADE BY—*Quality Specialty Co., Inc., 211 N. 2nd St., Philadelphia 6, Pa.* **330**

Furnace

NAME—Space saver.

PURPOSE—Space heating.

FEATURES—Unit is fired with the Gilbarco GCS burner with a patented action that starts the burner fan in operation before the oil is ignited and which permits the fan to continue operation for several seconds after the flame has ceased. The counterflow principle of heat transfer is employed by which the hot combustion gases move opposite to the flow of heated air. This is a packaged unit with the various parts installed and completely wired. Combustion chamber is of stainless steel. Unit occupies 3½ sq ft of floor space.

SIZES AND CAPACITIES — 100,000 Btu per hr.

MADE BY—*Gilbert & Barker Mfg. Co., West Springfield, Mass.*.....**331**

Sludge Remover

NAME—Houghto-Solv.

PURPOSE—Fuel oil additive for removing sludge from fuel oil systems.

FEATURES — Product is added to the fuel oil supply so that sludge may be removed from fuel system.

MADE BY—*E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.* **332**

OCTOBER, 1948

TO OBTAIN FURTHER INFORMATION ON NEW EQUIPMENT

On the list below, circle the item number of the equipment in which you are interested, using the number found at the end of each item.

295	296	297	298	299	300	301	302
303	304	305	306	307	308	309	310
311	312	313	314	315	316	317	318
319	320	321	322	323	324	325	326
327	328	329	330	331	332		

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Title (Must be shown).....

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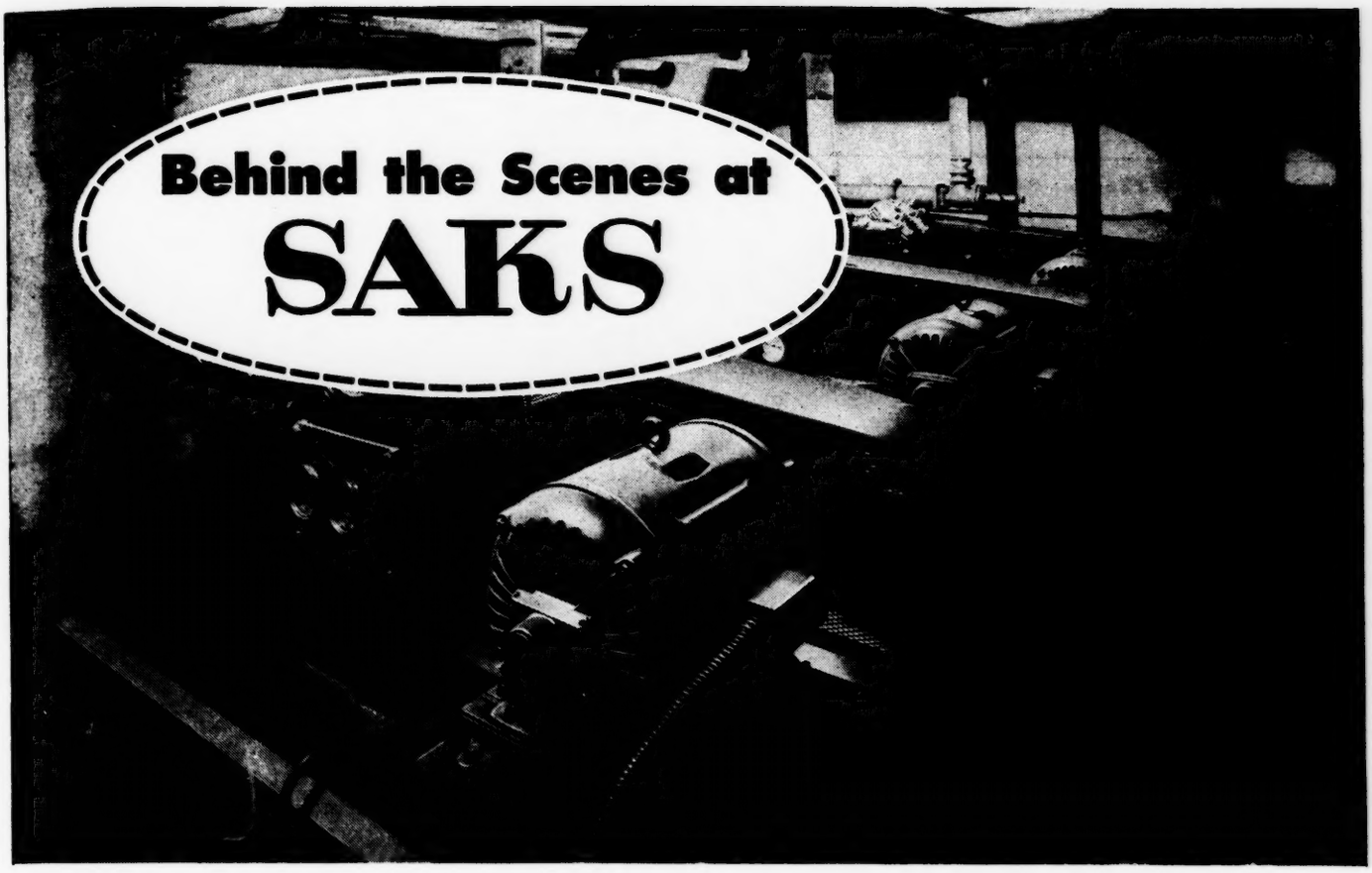
(For prompt service, title and firm name must be shown above.)

Business Address.....

City.....**Zone**....**State**.....10/48



Wagner *Quality* Motors help Build Patronage...

Operators of fashionable shops are quick to realize how well the installation of an air conditioning system can build patronage for their establishment. At Sak's 5th Avenue, in Beverly Hills, customers relax and shop in cool comfort—thanks to the efficient air conditioning system pictured above.

Air conditioning engineers specified, and used, Wagner Motors in this installation... as in thousands of industrial, commercial and home applications... because of their unfailing dependability! Dependable continuity of operation, outstanding service and economy are qualities found in every Wagner Motor. That's why you see Wagner Quality Motors on the job everywhere, driving all types of apparatus that help people live in year 'round comfort.

Hundreds of equipment manufacturers have standardized on these outstanding motors. Wagner can help you, too. If you manufacture or use motor-driven equipment, it will pay you to investigate Wagner Motors. Quick, convenient, nationwide service facilities are available to users of Wagner Motors. Twenty-nine branch offices, located in principal cities, are ready to give you service and advice. Contact our nearest office, or write us for bulletins on the complete line.

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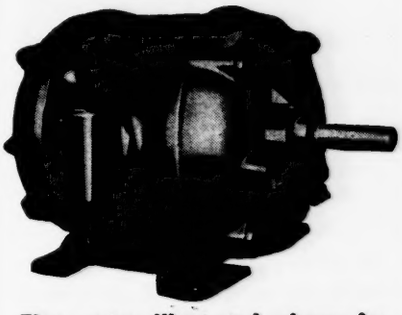

The motor illustrated above is typical of the Wagner complete line of polyphase and single-phase motors.

Consult Wagner Engineers on all Electric Motor Problems

Wagner Electric Corporation
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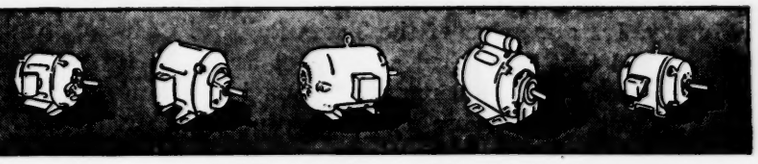


M48-5

• ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE PRODUCTS •

NEWS OF THE MONTH

ENOUGH OIL

for next winter's demands is predicted by Interstate Oil Compact Commission.

The Economics Advisory Committee of the Interstate Oil Compact Commission, comprising some of the nation's top oil economists, reports that enough oil to meet a 7% rise in next winter's demands will be available. The Committee's report was modified by the reservations that (1) domestic crude oil production must be pushed up to 5.6 million barrels daily; (2) production of natural gasoline—vapor extracted and condensed from natural gas—must average 415,000 barrels daily; (3) imports during the winter must exceed exports by 200,000 barrels daily; (4) stocks of crude and its products must have been built up during the summer sufficiently to permit winter withdrawals at a rate of 180,000 barrels daily.

• **MAY BE.**—The record so far indicates that these four conditions may be met. Daily production is already averaging 5.5 million barrels. Production of natural gasoline in the second quarter of 1948 was 388,000 barrels daily. In the first half of 1948 imports topped exports by about 113,000 barrels daily. Stocks of crude and its products increased 357,000 barrels daily in the second quarter of 1948.

To prevent consumers from becoming over optimistic, the committee warns that crude oil inventories are low, military demands may increase, refineries must increase yields of distillate fuel oils and kerosene, refinery capacities must be increased and consumers should strive for economy and efficient use of petroleum products.

• **COMMISSION.**—The oil industry in general and the Interstate Oil Compact Commission members in particular will use the committee's forecast as a guide in planning for the winter ahead. Commission members represent oil-regulating bodies of 21 oil producing states. These states produce 90% of the nation's gas and 80% of its crude oil.

Work of the Commission is done through committees. The legal committee, for instance, has drafted a model conservation statute. The research committee has investigated secondary recovery, synthetic fuels and other problems. Other committees keep the Commission advised on regular current practice, economic outlook, etc.

• **STEEL.**—Steel production was said to be the key to public oil supply at the closing session of a meeting of the Interstate Oil Compact Commission in the Hotel Roosevelt, New York, last month. William J. Murray, Jr., a member of the Texas Railroad Commission, said that Texas had gone about as far as it could in expanding petroleum production in existing fields without endangering future production. Mr. Murray said that compression plants and pipelines are needed to end waste of casinghead gas, which he estimated was being burned in flares now at the rate of 1.5 billion cubic feet daily. This gas could be saved only if sufficient steel were made available for its transportation and storage. Steel for other equipment used in the production, storage and transportation of petroleum products is the key to adequate supplies.

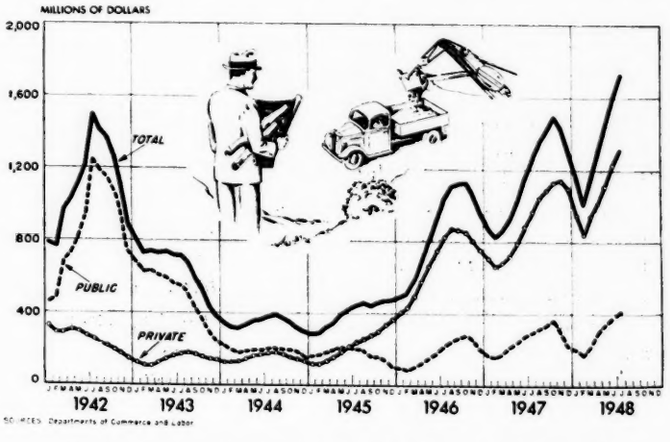
A report of the commission's Secondary Recovery Advisory Committee stated that the so-called depleted fields of five states probably could produce an additional 5 billion barrels of oil with secondary recovery methods.

• **CONVERSIONS.**—Power and heating conversions by industry from coal or other fuels to oil should still be made with restraint and only after obtaining assurance of continuing supply, David L. Barrett, Esso Standard Oil Company executive, advised a forum meeting of the Purchasing Agents Association of New York. He described the present supply situation as more comfortable than at any time since the end of World War II, but added that the margin still is too small to encourage expansion of oil markets.

NEW CONSTRUCTION ACTIVITY

tops monthly records as Pacific Coast region moves to front ranking position in dollar value of new work.

Nearly $1.75 billion worth of new construction established a new high record for the month of July, according to joint estimates by the Departments of Commerce and Labor. This marked the second successive month in which new construction activity surpassed all previous recorded peaks. With July figures now in, total value of new construction activity this year in 1948 reached $9.4 billion—36% above that for the corresponding 7 month period of 1947.



New construction activity in dollars, unadjusted.

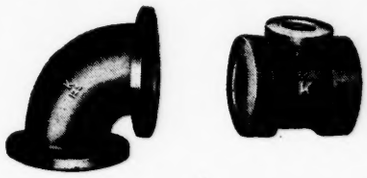
• **PRIVATE.**—Privately financed new constructions accounted for more than three-quarters of the July total.

Sure, a steamfitter is happy when he finishes up a job that he's proud of.

The use of "K" fittings helps. They're machined true. They make up straight and tight. The threads and flanges fit.

It takes that kind of fittings to do a bang-up job. Makes the work easier, too.

"K" fittings are precision-cast, precision-machined, precision-inspected. Ask for them when you order fittings from your supplier.



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DAYTON 1, OHIO

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Now! A Complete FACTORY HEATING SYSTEM *is Available for* **Immediate Delivery**

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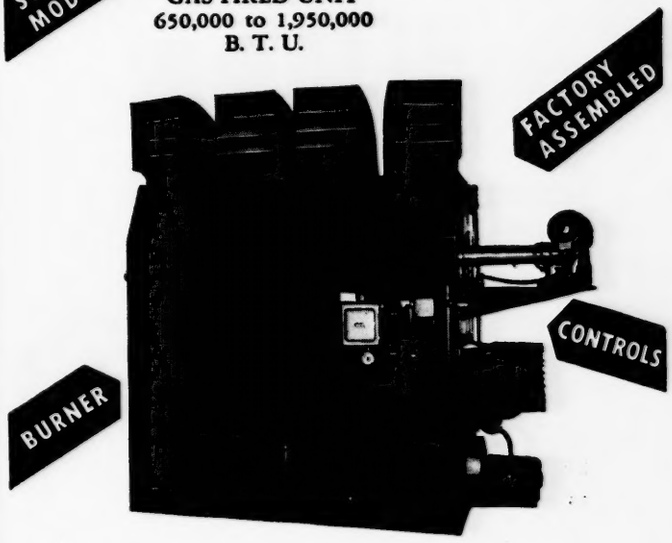

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Write for Bulletin 802 giving complete specifications on Airtherm Direct Fired Heaters.

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Privately financed residential construction put in place was valued at $667 million, non-residential was $333 million. The value of work put in place is defined as equivalent to the cost of materials installed plus estimated expenditures for labor and overhead during the period of record.

• **BY REGION.**—The analysis of construction activity by geographical regions indicates that the Pacific Coast region (California, Oregon and Washington) move into the front ranking position in dollar value with 19% of the national total of new construction put in place during the first half of 1948. Second, with 18% of the national total, was the East North Central region (Illinois, Indiana, Michigan, Ohio and Wisconsin). Middle Atlantic states were third with 16% of the total. Among the individual states, California with $1,148 million, Texas with $573 million, and New York with $547 million combined to account for almost 30% of total U. S. construction activities in the first six months of the year.

• **PRICES.**—Uninterrupted for many months, costs of construction continued their steady advance during June (latest month for which data are available). The June index level (with 1939 equal to 100) rose to 212, an almost 13% increase over June, 1947. Wholesale prices of building materials also advanced although at a slower rate. The Bureau of Labor Statistics' composite index of building material wholesale prices rose to 217.5 during June, a gain of 13% above the level of last June. Steepest gain during the past year has been in prices of heating and plumbing equipment (22%) and structural steel (20%). Notable, however, is the fact that the plumbing and heating index is still third from highest (183.5) among seven listed by BLS, while the structural steel index is second from the bottom (142.9). Runaway of construction materials is lumber with an index of 336.1. Most conservative is cement with an index of 141.1.

TANKS EXPLODED

at demonstration to show importance of temperature control for domestic hot water tanks as safety measure.

Four 30-gallon domestic water tanks were destroyed —three by explosion and the fourth by external rupture to show what takes place when water in a closed system hot water tank is overheated. The demonstration on September 14 witnessed by 175 engineers, insurance officials and municipal representatives, was arranged by Watts Regulator Co., Lawrence, Mass., at the farm of R. D. Bitzer, Doylestown. Pa.

A 30-gallon galvanized steel tank was set vertically in an open field. A closed system was established with a pressure relief valve installed to bleed water from the tank as the water heated so that a predetermined pressure could be maintained.

• **TANK EXPLOSION.**—The original plan was to raise

Flash steam and flying fragments of tank mark failure of hot water tank at 265F and 50 lb per sq in.

the temperature of the water to about 300F and then to increase the water pressure until the tank ruptured and exploded. However, the explosion took place earlier than expected. Therefore, the test was repeated for the benefit of those who arrived too late to see this demonstration.

On the repeated test, the tank exploded when the water had reached a temperature of 265F with pressure at 50 lb per sq in. With the explosion, parts of the boiler blew into the air and over a wide area. Later examination disclosed that one of the heads blew off, the boiler itself was ruptured and flattened, with failure occurring at the line of vertical weld.

• **TANK IN HOUSE EXPLODED.**—In test No. 3, a 30-gallon copper tank was installed inside a cabin to show the destructive force of liberated energy within an edifice. A copper tank was used in place of the galvanized steel because copper tanks, it was found, exploded in a more spectacular manner. When exploded, galvanized tanks sent the parts out over a wide area while copper tanks soared for a considerable vertical distance.

Water in the copper tank was heated to 260F with the pressure held at 50 lb per sq in. At this point a shot was fired at the tank to build up additional pressure through water hammer. The resulting explosion sent parts of the cabin and tank about 200 ft into the air with one part of the tank descending 400 ft from its original location. The copper tank was ruptured at its midpoint as though cut with shears. A tank head landed at a remote spot. Nothing remained of the cabin but small portions of the lumber scattered over a large area.

• **LESSONS LEARNED.**—Those in charge of the demonstration pointed out that in the three explosions, that the pressure developed in the tanks was well within the safe limits for the tanks as constructed. They

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Whatever your fuel oil heating problem, there's a **standard** Whitlock heater to produce the oil temperature and viscosity you need. Fuel oil heaters, loading oil or line heaters, suction heaters and manhole coil type heaters are all available to handle the individual problem. Whitlock engineers will be glad to consult with you and suggest the right unit for your needs.

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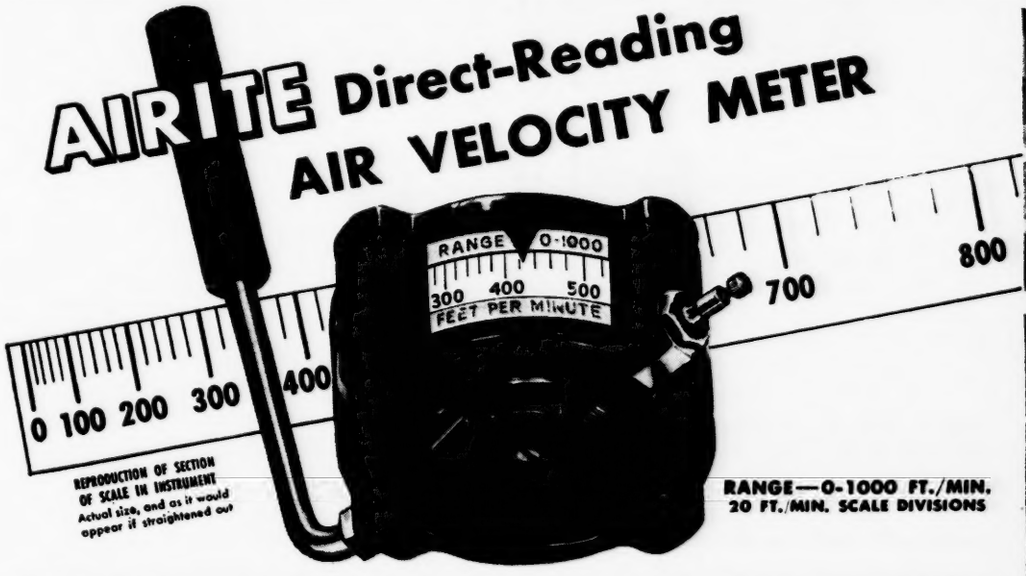
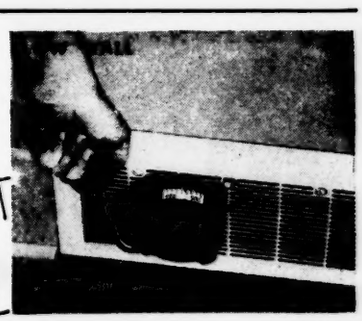
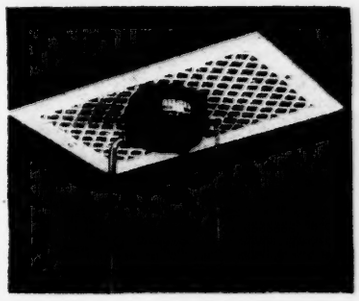


REPRODUCTION OF SECTION OF SCALE IN INSTRUMENT
Actual size, and as it would appear if straightened out

RANGE—0-1000 FT./MIN.
20 FT./MIN. SCALE DIVISIONS





8" SCALE—Widest Scale of Any Mechanical Air Velocity Meter Ever Designed!

The AIRITE is an unsurpassed sales and service aid in heating, ventilating and air conditioning work. On installation and service work it is used to determine velocity and direction of air flow from registers and grilles for the purpose of checking rate of air delivery, balancing the system and adjusting deflecting vanes and louvers of registers so as to obtain "draft free" air distribution. These tests cut installation and service time, prevent expensive call-backs, and promote customer goodwill. The AIRITE is equally helpful for selling new equipment or modernization. It can be used in many ways to convincingly demonstrate discomforts and inefficiencies of a worn-out or inadequate system.

The AIRITE is entirely self-contained. It has no hose or probe, and gives all readings required for heating, ventilating and air conditioning work. The detachable handle facilitates use of the AIRITE at low wall or high side wall registers. By screwing a ⅜" pipe into the handle the AIRITE can be conveniently held against ceiling grille.

The AIRITE is equipped with a unique scale lock which makes it possible to retain the reading until the lock is released. For ceiling grille readings, this lock is easily manipulated by means of a piece of string. This feature makes the AIRITE exceptionally adaptable for indicating air velocity in hard-to-reach or dimly lit locations.

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summarized their findings by stating, "Excessive pressure causes a tank to rupture; excessive temperature causes a tank to explode. Pressure enables excessive temperatures to be reached within the boiler."

• **PRESSURE.**—To substantiate this summary, another test was completed. A closed system was set up for a 30-gallon galvanized steel tank. The bleed valve provided on previous set ups was closed so that pressures could be increased. Water within the tank was heated to 195F, and by means of a pump, pressure was built up to 150 lb per sq in. At this point, W. M. Dillon, Chief Engineer, Watt Regulator Co., who was in charge of the demonstration, struck the side of the tank with a sharp pointed sledge hammer to pierce the metal. Water spurted from the hole for about five feet but there was no explosion. The temperature had been held down to a safe limit.

• **ENERGY RELEASED.**—At a pressure of 50 lb per sq in., a 30-gallon tank holding boiling water would release through tank failure 2,021,900 ft lb of energy, an amount in excess of the destructive effects produced by blasting one pound of nitro-glycerine.

• **PROGRAM.**—During the program, talks were made by John Dale, chairman, National Research Committee, American Society of Sanitary Engineers; W. M. Dillon; Edward Zimmer, director, Plumbing Department, Chicago Testing Laboratory; George Horne, vice-president and general sales manager, Watts Regulator Co.; R. D. Bitzer and others.

The company plans to hold similar demonstrations at other parts of the country.

SUN-HEATED HOME

ready for tests through Boston winter, has solar heat trap and no auxiliary heating.

Dr. Maria Telkes of the Massachusetts Institute of Technology will spend her winter weekends in a $20,000 house with a $3,000 solar unit that traps and stores heat in chemical bins. Dr. Telkes described the system in a paper presented to the American Association for the Advancement of Science during the annual meeting of that Association in Washington, D. C., last month. The house is in Dover, 15 miles from Boston.

• **IN ROOF.**—Dr. Telkes explained that the heating unit will be built into the roof of the five-room one-story house in the form of a collector of sun rays consisting of an 800-sq-ft black metal sheet behind two glass plates acting as a heat trap.

Air is circulated behind the metal sheet in ducts, and when warmed is conducted to "heat bins" at strategic points throughout the house; each connected to registers and each capable of serving two rooms. Warm air is blown from the heat bins through the registers into the rooms.

• **STORAGE.**—The heat is stored in the bins in a new way, Dr. Telkes reported—in a chemical heat-storage container, at 90F, the chemical melting as the heat is stored in it. She described the chemical (H&V:5:47: p 68) as a cheap sodium compound known as sodium sulfate dekahydrate. When the chemical solidifies, the latent heat is given off again, and the chemistry of the problem has been worked out so that enough heat will be available whenever it is needed.

• **DESIGN.**—Calculations used in working out the heating system included sunshine data made available by Irving F. Hand, of the Blue Hill Observatory, which is two miles from the house, Dr. Telkes said. She explained that the device operates in such a way that heat can be stored for ten days, and this is worked out so that enough heat will be available at all times —at comfortable temperatures—even taking into consideration the fact that on some days bad weather cuts down the availability of rays from the sun.

The heating system itself costs virtually nothing to operate—if it lives up to expectations, it will save an annual average fuel expense of about $150—and the storage chemical lasts indefinitely and presumably will never have to be replaced, Dr. Telkes said.

• **SPONSORED.**—The house in Dover, which will be ready for occupancy in October, is on the estate of Miss Alelia Peabody, a sculptor, who is building the house as a private project because she is interested in solar energy. Dr. Telkes said the architect is Miss Eleanor Raymond, of Boston. She said the project grows out of experiments in such matters at M. I. T., and these original experiments were made possible by gifts from Godfrey Lowell Cabot. The Dover project, however, is privately sponsored by Miss Peabody.

ARCTIC SHELTER

designed to provide 70F comfort inside with temperature at −70F outdoors.

Preparing for the eventuality of a cold war in the literal sense, the United States Army is testing a new type of troop shelter that promises bug-in-the-rug comfort even when a 70-below-zero storm howls outside.

Details of the prefabricated shelter, which is light enough to be transported in gliders with a detail of troops, have been announced by the Corps of Engineers. The band of rugged engineers sent on a testing mission to the Arctic were to determine whether thermostatically-controlled heat in the shelter would remain a snug 70F inside while outside temperature hit 70 below zero and wind reached a velocity of 125 miles an hour. That was the severe prerequisite of the Army.

• **HUMIDITY.**—Carrying the atmospheric control further, the Army also had engineers of Minneapolis-Honeywell Regulator Co. provide automatic devices that would maintain relative humidity at 35% in the

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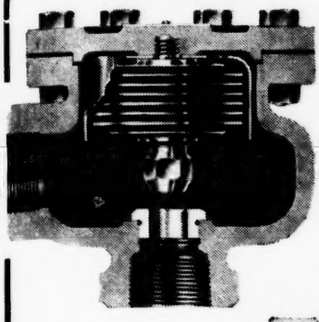
LARGEST CAPACITY



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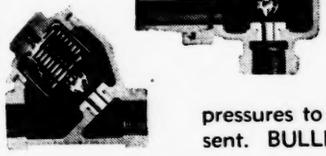

Comparative tests by large trap users show: record low for steam waste; 2 to 6 times average drainage capacity; operate on lowest temperature differential; no freeze-ups; greater simplicity (fewer spare parts). 5 types for every purpose; size ¼" to 2"; pressures to 225 lbs. Test trap gladly sent. BULLETIN 1047.

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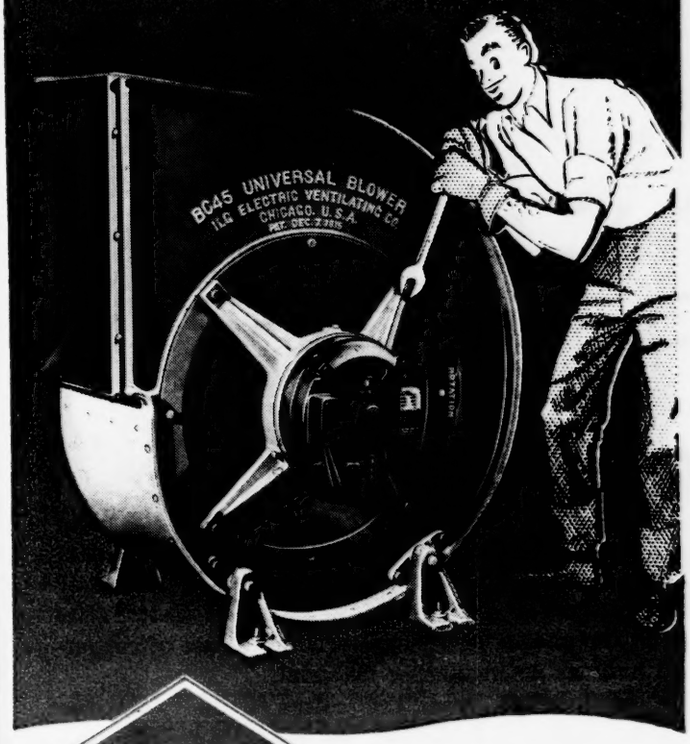

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shelter. Experience has shown that humidity control is extremely important in frigid climates, especially in hospital units.

• **SIMPLE.**—Designed like a full-size erector set, the shelter can be erected by unskilled men wearing arctic clothing, including heavy gloves. Panels, made up of a sandwich aluminum skin, filled with an insulation material, are fastened together on the frame to form the floor, walls and roof. Sections are interchangeable, so even a man with a handicraft quotient of zero has no trouble assembling them.

Connected in units of 20 by 8 ft, the buildings can be expanded in any direction in increments of 8 or 20 ft modules to any size without using special connecting devices. Floors will have a linoleum cover and the home-like atmosphere will be enhanced by use of a warm color paint inside.

COTTONSEED HULLS

as an insulating material investigated by Texas Engineering Experiment Station.

Professor W. B. Long of the Texas Engineering Experiment Station, the Agricultural and Mechanical College of Texas, has completed a research report of an investigation in cooperation with the Cotton Research Committee of Texas covering the use of cottonseed hulls as an insulating material.

In an average year, the cotton industry in the United States produces about 1 million tons of cottonseed hull as a by-product. Present day uses of this material have been limited, and Professor Long's investigation was undertaken to fill a gap in insulation engineering data concerning the product.

• **TESTS.**—The shielded box method of heat transfer determination is used in the experiment. The first test was made on a sample of cottonseed hull having average lint. The hulls were filled with test panel from a constant high to insure uniform condensity. After thermal equilibrium was established, the test was continued for four hours and the average data used to calculate k values. This procedure was used in all subsequent tests.

• **DATA.**—Results of tests are shown graphically in Fig. 1 and 2. Fig. 1 shows the variation of conductivity with average temperature of the insulating material. All tests were made with an average hull condensation of approximately 10.6 lb per cu ft.

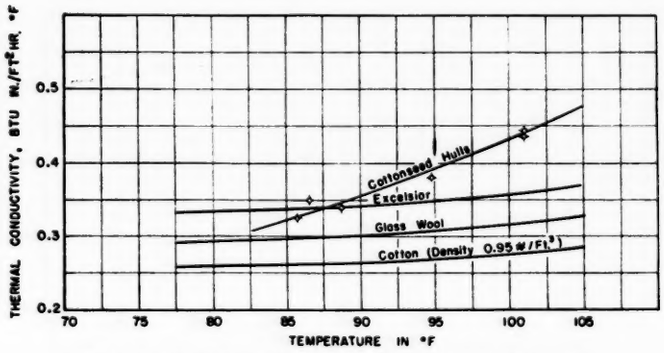


Fig. 1. Conductivity of cottonseed hulls and other insulation.

In the range of temperatures of about 95F upward, cottonseed hulls are about 88% as effective as excelsior, 78% as effective as glass wool, 68% as effective as cotton. In lower temperature ranges cottonseed hulls compare favorably with glass wool and cotton and have a lower conductivity than excelsior. Tests did not extend into temperature ranges below 80F.

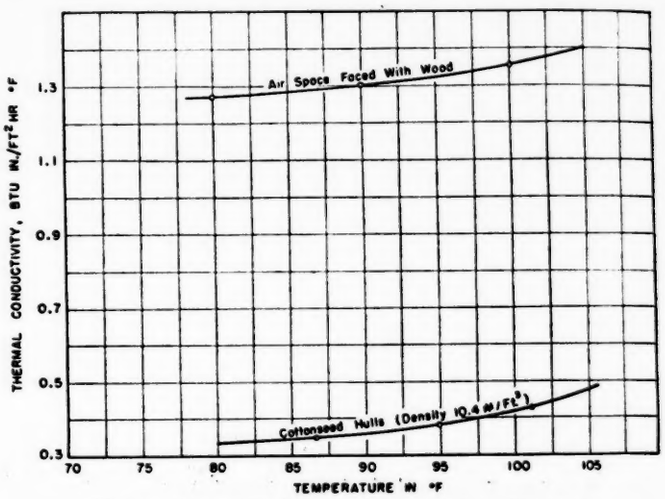


Fig. 2. Conductivity of cottonseed hulls and 1½-in. air space.

Fig. 2 compares conductivity of cottonseed hulls and a 1½-in. air space faced with wood surfaces on each side. The fact that the two curves are practically parallel is interpreted to indicate that insulating value of cottonseed hulls is a function of the air spaces contained by the hulls rather than any other property they may have.

Conductivity of cottonseed hulls was established to average .38 (Btu) (in.) per (sq ft) (hr) (F) in the temperature range of 80 to 100F. The value of k at lower temperature ranges would be lower and compare with other types of insulation.

HEATING PREFERENCES

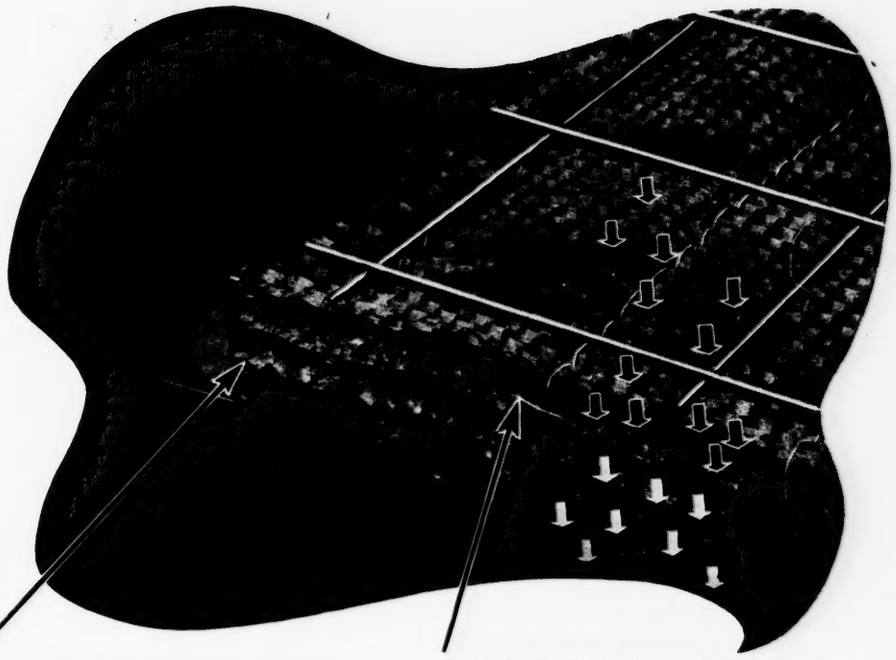
established by consumer panel shows comfort as deciding factor in home heating equipment selection.

A summary of replies to a questionnaire on the subject of heating which was sent to 2,007 members of *The American Home* reader-consumer panel in February shows comfort and warmth far in the lead among important factors in selecting a heating system.

Replies were received from 1,690 members (84%) representing an exact cross section of the readers of *The American Home.*

• **COMFORT.**—Comfort and warmth, say panel members, is half again as important in selecting a heating system as any other single factor. What's more, they rate upkeep *seven* times more important than

IN AIR FILTERING THE *Self-Seal Edge* MAKES A DIFFERENCE



The Research Self-Seal Air Filter is built slightly over size, and fits snugly into the holding frame with a self-sealing edge that absolutely prevents any bypass of unfiltered air.

All circulating air must pass through the filter media, where thousands of tiny baffles cause a turbulent action in the air stream, and effectively scrub out dirt, dust, lint and pollen.

RESEARCH *Self-Seal* AIR FILTERS

MANUFACTURED BY **RESEARCH PRODUCTS CORP., MADISON 10, WISCONSIN**

MANUFACTURERS OF QUALITY PUMPS FOR OVER A QUARTER OF A CENTURY

SPECIFY SKIDMORE PUMPS

- - - for Performance!
for Low Upkeep!

Type H S Pump will handle condensate requirements very satisfactorily from steam heating and process equipment.

Model No. H S

Write for Bulletin No. 14 A-H

SKIDMORE PUMPS

ST. JOSEPH, MICHIGAN

Completely UNDER CONTROL!

THE NEW 500 M.V. B-60 COMPLETELY SELF-CONTAINED AND SELF-OPERATING CONTROL SYSTEM ORIGINATED BY *General Controls*

★10 years of proven performance.

For natural, manufactured or L.P. gases. For domestic, commercial and industrial applications. System consists of the B-60 pilot operated diaphragm type gas valve, the T-70 Series Snap-action Thermostat, which is scientifically correct in design, and the new improved ingenious PG-9 Pilot Generator which produces 450 to 500 millivolts of operating current, also safety control and main burner ignition.

FOR COMPLETE SPECIFICATIONS request new Catalog

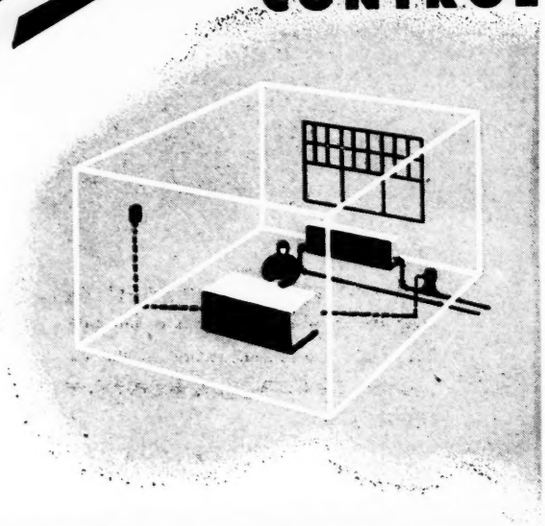
GENERAL CONTROLS

801 ALLEN AVENUE GLENDALE 1, CALIF

FACTORY BRANCHES and DISTRIBUTORS IN PRINCIPAL CITIES

BARBER COLMAN

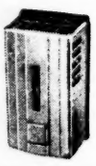
Individual ROOM CONTROL



SATISFIES OCCUPANT'S PREFERENCES....

Here is a sure way to keep everyone satisfied . . . to meet the personal preference as to room temperature. Individual Room Control — a Motor-Operated Valve on the radiator, controlled by a thermostat *in the same* room gives each occupant the chance to enjoy a chosen degree of warmth. Installation is easy . . . valves come Completely assembled, *low voltage* wiring is economically installed in new or existing buildings.

Packless Radiator Valve for low Pressure Steam



Standard Low Voltage Room Thermostat

For

OFFICES • HOTELS • HOSPITALS
SCHOOLS • CHURCHES • INSTITUTIONS

The system can be installed room by room, in parts of the structure, or in the whole building as maintenance budgets may permit. Individual Room Control offers important overall economy and savings of fuel. For specific suggestions consult your Barber-Colman representative, or write direct to us.

BARBER-COLMAN COMPANY
1224 ROCK ST. • ROCKFORD, ILLINOIS

cost. Forced warm air is their favorite heating method; gas, their favorite fuel—for reasons given below.

"What do you think are the most important factors in selecting a heating system?"

Comfort and warmth	81%
Cleanliness	52%
Low operating cost	49%
Durability	46%
Ease of operation	46%
Low initial cost	7%
No answer	3%

"What kind of heating do you prefer?"

Forced warm air	28%
Forced hot water	16%
Radiant panel	15%
Gravity hot water	9%
Steam	8%
Gravity warm air	7%
Vapor-vacuum	2%
No answer	19%

"What fuel would you choose if you were installing a new heating plant?"

Gas, including natural gas (3%)	44%
Oil	31%
Coal	12%
Electricity	3%
All others	2%
Don't know	3%
No answer	8%

"Would you tell us the reason for this preference?"

Percentage of—	those choosing gas	those choosing natural gas	those choosing oil	those choosing coal	those choosing electricity
Cleanliness	57%	46%	48%	6%	75%
Comfort, warmth	13%	7%	11%	17%	15%
Dependable, efficient	7%	7%	5%	6%	14%
Most satisfactory	9%	15%	13%	7%	....
Ease of operation	47%	32%	54%	4%	29%
Low operating cost	31%	69%	16%	36%	19%
Quick heat	2%	2%	1%	1%	6%
Certain supply, easy to obtain	11%	30%	4%	50%	8%
All others	17%	15%	15%	19%	27%
No answer	3%	2%	5%	3%	8%

CORROSION ENGINEERS

mark four years of steady growth of national association.

Started in 1944 by only a dozen pipeline engineers who sought to do something about the Nation's $1 billion annual corrosion bill, the National Association of Corrosion Engineers in 4½ years has grown to include more than 1400 active members and 190 company members.

• **MEMBERSHIP.**—The active members ($7.50 annual dues) are principally engineers working on corrosion problems employed by companies in 32 industries, by various Federal, State and municipal agencies, and by the military services, universities and engineering consultants. Last April nearly two-thirds of the enrolled members attended the annual conference and

exhibit in St. Louis, and listened to the 44 technical papers presented there.

Company members ($100 annual dues) are representative of 18 industries including telephone, steel, oil, gas and electric, railroad, chemical, dye, nickel, glass, paper, water supply, etc.

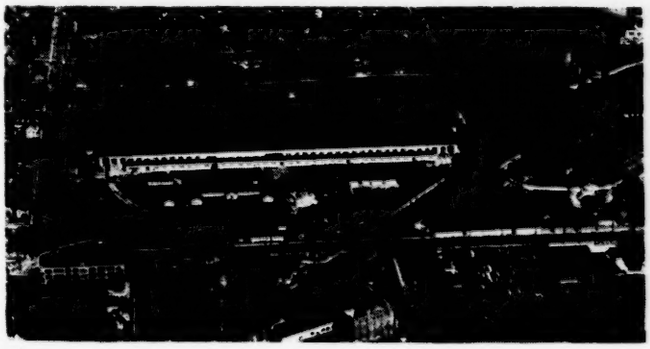
• **ACTIVITIES.**—For dealing with soil-induced corrosion, NACE sparks the Correlating Committee on Cathodic Protection which is sponsored officially by it and several other associations. This group seeks through education of managers and engineers to reduce corrosion of buried metal structures including 988,000 miles of oil, gas and water pipe, 167,00 miles of metal-sheathed communications and power cable and 425,000 miles of rail track. For reducing duplication and increasing the efficiency of work of various technical societies on corrosion problems, NACE has accepted responsibility for carrying on the functions of the war-born American Coordinating Committee on Corrosion, now called the Inter-society Corrosion Committee. It will have a member from each of a number of societies and associations working on corrosion problems.

NACE is governed by officers and directors elected by the members, and by a small paid office staff headquartered at 905 Southern Standard Bldg., Houston 2, Texas, under A. B. Campbell, executive secretary. This year's president is F. L. LaQue of The International Nickel Co.

PUMP PLANT

on 19-acre site ready for Peerless personnel in Indianapolis.

Movement of both personnel and equipment into its new 19-acre plant site at Indianapolis, Indiana, has been completed by Peerless Pump Division of the Food Machinery Corp. Located approximately two miles from the heart of downtown Indianapolis at 2005 Northwestern Ave., the new plant, formerly the Fall Creek Ordnance Works, contains 261,000 sq ft of floor space in its main building. A second 30 ft by 800 ft structure comprises locker and shower accommodations for over 1200 employees. Remodeling of this section has been made to include a dispensary, receiving and shipping department offices. This building is, in turn, flanked by a 4500 sq ft area housing the



Air view of Peerless Pump plant.

BARBER COLMAN

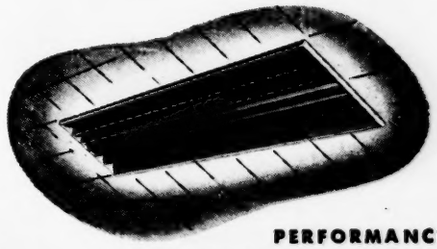
Line-O-Flo

CEILING OUTLETS

These new line-type ceiling outlets can be used singly or end-to-end in continuous strips. They are constructed of scientifically-designed, rolled-steel members all dimensionally coordinated for use with acoustical ceilings and other building products.

A New Approach to Air Distribution

Keyed to modern architectural concepts, LINE-O-FLO, provides a vital contribution to continuity of design. High diffusion efficiency results in rapid induction of room air into the primary stream, quickly equalizing the temperature differential.



PERFORMANCE DATA ASSURES ACCURATE ENGINEERING

Knowing the CFM available and the throw required, the number of standard units needed can be quickly obtained from reliable Performance Data tables. Two basic models are made — Model "LS" (shown above) and Model "LL" (designed to receive M21118 DAY-BRITE Lighting Unit).

Ask for Bulletin F-2741 and get full performance data, dimensions, description, principles of operation, typical installation methods, and suggested uses. Write today.

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McCORD
HEATING AND AIR CONDITIONING PRODUCTS

BLAST HEATING COILS—AIR CONDITIONING COILS—ALL TYPES

All copper spiral fin tube construction with the tubes formed or bent permits uniform expansion without strain. Headers are heavy wall construction with tubes brazed into extended ferrules formed in the headers. Fins are helically wound and metallically bonded. May we send catalog?

VERTICAL TYPE UNIT HEATERS

A proven heating unit, modern in design, incorporating every unit heater advancement. McCord copper spiral fin tube construction creates air turbulence without undue restriction. Improved fan blades deliver large volume of air with minimum air noise. Guaranteed for 150 lbs. saturated steam pressure. Specify McCord.

HORIZONTAL TYPE UNIT HEATERS

A time proven heating unit, modern streamlined in design, quiet, yet its rugged construction adapts it to all types of installations, guaranteed for use on No. 150 p. s. i. steam pressure. All copper heating element, individual spiral fin tubes free to expand without strain on joints. Standard motors with standard bases used. Wide range of capacities.

Save fuel with McCord Unit Heaters.

McCord CORPORATION
DETROIT 11, MICH.

production, management and control sections. Peerless Pump Division's main office building at Indianapolis now comprises some 11,000 sq ft, with an adjacent building of similar design, of 1700 sq ft, remodeled for use as a sales training building.

• **SPUR.**—Two spur tracks served by the CCC & St. Louis (Big Four) Railroad were in place with easement cross-over across the city street. This easement has been extended to the company. These spur tracks enter the main factory building; one at the north and the other at the south end. The spurs will accommodate six 50-ft cars within the building at each end. The spur at the north end has been extended to loop the plant on the outside, thus giving through traffic to incoming carloads. At each end of the plant at each of the four corners are motorized cathead car pullers for pulling cars along the spur inside the plant and for pulling cars in from outside the plant.

Electricity is furnished from a nearby steam power station. The plant will ultimately offer employment to approximately 800 persons. Works manager of the Peerless Indianapolis plant is H. J. McKenzie; assistant works manager is C. N. Adams.

NEWS BRIEFS

• Shipments of complete *air conditioning equipment* and components and accessories for air conditioning and commercial refrigeration during 1947 were valued at $200 million, according to the Bureau of the Census, Department of Commerce. Of this total, shipments of components and accessories represented 81%.

• The Federal Trade Commission has ruled that *air conditioning, by definition,* is control by a mechanical device, of the temperature, humidity and circulation of air within a structure. Non-performance of any one of these three basic functions takes equipment out of the air conditioning class. Air conditioning equipment *may* perform more than these three functions. It may, for example, filter the air.

• The Naval Medical Research Institute and the Office of Naval Research are sponsoring studies of the rapid measurement and recording of *heat exchange between man and his environment* at the ASHVE Research Laboratory.

• Work on the *lignite research laboratory* to be constructed at a cost of $750,000 by the Bureau of Mines at Grand Forks, North Dakota, will start immediately. Completion of the project is scheduled for the end of 1949.

• There are *91 new hospitals* housing 51,262 beds either completed, under contract, or in the planning stage, in the construction program of the Veterans Administration. The total available for construction of new hospitals is $1.02 billion.

• A new *humidity control for protecting barns,* livestock and farm equipment has been announced by Minneapolis-Honeywell Regulator Company. The system will control fans and other devices, automatically maintaining temperature and humidity at desired levels. It will be distributed through wholesalers of farm and electrical equipment by Brown Instrument Division of Honeywell.

• Texas Gas Transmission Corporation started construction in September of a *63-mile, 26-inch pipeline* extending from Lula, Mississippi to Memphis, Tennessee. On approval by the Federal Power Commission, the 63-mile section will become part of a projected 840 mile line running from Texas to Ohio.

• The Cambridge Gas Light Co. of Cambridge, Mass. is *changing existing facilities* from the manufacturing of 528-Btu carburetted water gas to 960-Btu oil gas. Unable to expand distribution facilities economically, the company figures that doubling the heat content of the gas will enable it to deliver twice as many heat units to customers.

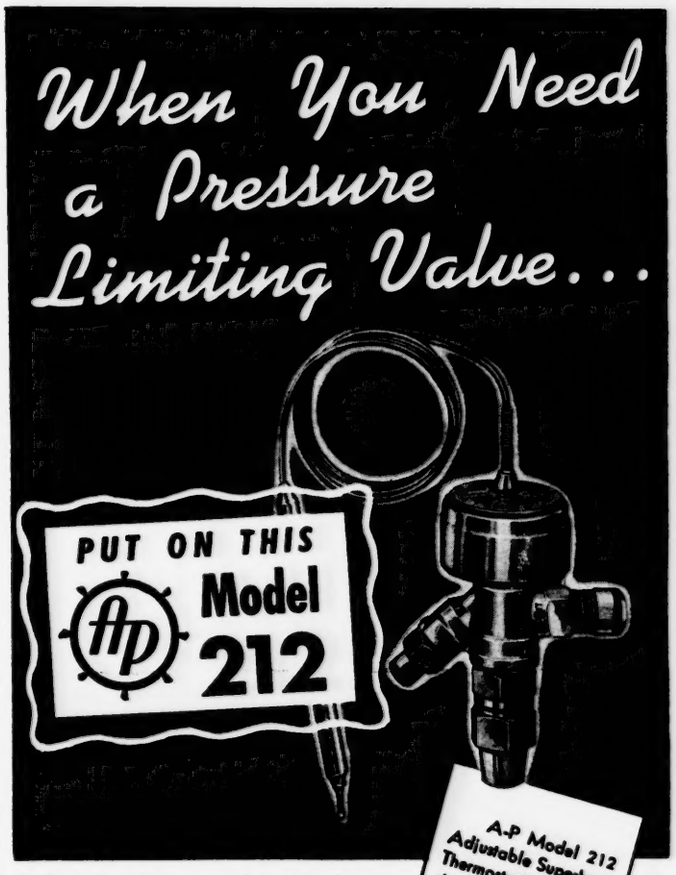
• The voluntary plan for *allocation of essential steel* in the anthracite producing industry has been approved by the Department of Commerce and Justice under provisions of Public Law 395 and will remain in effect until March 1, 1949.

• One of the *deepest installations of boilers* ever made took place recently when the Pere Marquette Building, New Orleans, owned by the Jesuit Fathers' Societe Catholique D'Education Religieuse et Litteraire and occupying an historic site on which the Jesuit High School once set, got a new heating plant located twelve feet below sea-level. Pacific Steel boilers were taken in piecemeal through a cellar door and reassembled.

• Agreement on *standards for pipe flanges and fittings* used in refrigerating equipment has been reached according to an announcement by the American Standards Association, Inc. A committee of national organizations, manufacturers and users of pipe flanges and fittings worked through procedures of ASA to agree on standard dimensions, materials and markings. Result is the new American Standard for Cast Iron Flanges and Flanged Fittings for Refrigeration Piping (Class 300).

• *Anthratube production* will receive new stimulation with the introduction to the market of the Bethlehem Foundry and Machine Co. The Bethlehem Anthratube includes the basic features of the Anthracite Institute design. The company anticipates producing 300 to 400 units a month.

• Carrier Corp. established a *new high record* of $55.7 million in completed contracts and sales during the twelve months ended July 31, 1948. The comparable figure in 1947 was $46.1 million.


When You Need a Pressure Limiting Valve...
PUT ON THIS
Model 212
A-P Model 212 Adjustable Superheat Thermostatic Expansion Valve with Limiting Pressure Feature

Valuable addition to the already-complete line of A-P Thermostatic Expansion Valves, the new Model 212 provides welcome "performance insurance" on any system where motor overload may be indicated. It offers advantages never before achieved in a pressure limiting thermostatic expansion valve.

You may install the A-P Model 212 in place of any standard thermostatic expansion valve of similar capacity (½ and 1 ton Freon or Methyl). Like all A-P expansion valves, it is liquid charged and may be mounted in any position or ambient temperature without affecting the control-accuracy at the bulb. Operating suction pressure is limited to a predetermined setting by an exclusive and entirely new diaphragm unit. This diaphragm actuates the needle pin, allowing the valve needle to move towards the closed position, until the overload condition has passed. Then the valve operates in the normal manner to control superheat through the thermostatic bulb and sensitive large-area diaphragm.

Cross section . . . showing new pressure limiting diaphragm unit.

Model 212 is available to limit pressures at 15, 40, and 55 lbs. Freon 12, and at 10 and 30 lbs. Methyl. Capacity, ½ and 1 ton Freon or Methyl. Model 211 with fixed superheat, same capacity, is also available.

Pick up the new A-P Model 212 at your Wholesaler, or write for Bulletin E-156, and condensed catalog.

AUTOMATIC PRODUCTS COMPANY

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DEPENDABLE REFRIGERATION VALVES

FOR HEATING . . . AIR CONDITIONING . . . REFRIGERATION

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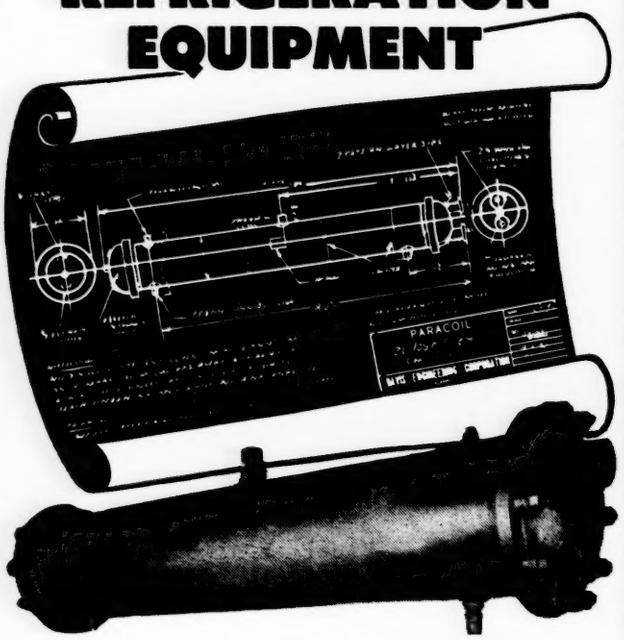

Freon Condenser
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Finned Copper Tubes
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EVAPORATORS **BRINE COOLERS**
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ABSTRACTS AND REVIEWS

Publications abstracted in this department should be ordered direct from publisher.

GAS SERVICE REFERENCE MANUAL

A most useful and practical publication for architects and builders is that of the "Reference Manual-Modern Gas Service," published by the American Gas Association. The manual, divided into 11 sections, covers the important domestic uses of gas in three different ways. The 11 sections are: kitchen planning, gas cooking, gas refrigeration, gas water heating, basements and utility rooms, gas heating, gas all-year air conditioning, modern home laundry, gas piping, chimneys, flues and vents, and, finally, a blank section for general and local information.

Each section contains, on white sheets, a general discussion of the subject, attractively illustrated with, where necessary, data and sketches. These sheets aid in determining the kind and size of equipment and explain installation or design practices. Second, in cases when possible, the white sheets are followed by installation specifications.

Third, in each section yellow-edged sheets give descriptions, illustrations and specifications of the various appliances furnished by their manufacturers who themselves keep these sheets up to date.

The section on heating is subdivided into steam, hot water, winter air conditioning, floor furnaces, space heaters and controls. The discussions on these subjects are all most competently handled, presumably by committees of utility house heating engineers.

Reference Manual-Modern Gas Service. Page size, 8½ x 11 inches, loose-leaf. Published by American Gas Association, 420 Lexington Ave., New York, N. Y. Price, $7.50.

BASIC PRINCIPLES OF HEATING AND VENTILATION

About 1937 Thomas Bedford, member of the scientific staff of Great Britain's Medical Research Council presented a series of lectures on the modern principles of ventilation and heating and which were then published in book form. Following the end of the war, when asked by his publisher to revise his book, Dr. Bedford proposed instead to prepare a fuller treatise on the subject. This has now appeared under the title "Basic Principles of Ventilation and Heating."

At first thought, one would assume that this would be a book on the fundamentals of engineering in the arts of ventilation and heating. This is not the case. Instead, the new volume deals with these arts in terms of basic human needs; that is, the author has gone thoroughly into the reasons why we need heating and ventilation, the effects of our thermal environment and associated matters, with a relatively small portion of the book dealing with the application of equipment.

One chapter alone—that on Scales of Warmth—is, in this reviewer's opinion, worth the price of the

book. Dr. Bedford has impartially and thoroughly discussed and compared the American effective temperature, the British equivalent temperature, and the French resultant temperature scales.

Other subjects treated in a most understandable and interesting manner in separate chapters are body heat production, warmth and comfort, sensations of warmth and cold, stimulating environments, air quality, measurement of ventilation, work at high temperatures, and effects of atmospheric conditions on accident frequency and sickness. On the application side are chapters on natural ventilation, mechanical ventilation, domestic heating, panel heating, convection heating, and air conditioning.

Basic Principles of Ventilation and Heating, by Thomas Bedford, 5½ x 8½ in., cloth bound, 401 pages. Published by H. K. Lewis & Co., Ltd., 136 Gower St., WC 1, England. Price, 25 shillings ($5).

PUBLIC HEALTH ENGINEERING

The field of environmental sanitation was broken up by the author into two major divisions—The Air Contact in Part 1, and Part 2, The Water Contact. The first part by Earle B. Phelps, Professor of Sanitary Science, University of Florida, is an expansion and outgrowth of lectures for a summer school course given many years ago at Columbia University.

In the section on the air contact he considers weather and climate; air supply of enclosed places; thermal environment of the human body; heating, ventilation and air conditioning; illumination and lighting; and atmospheric pollution. Included is a special chapter on Insects and Insect Control by Dr. Harry D. Pratt of the U. S. Public Health Service.

The Water Contact by C. J. Velz, Head of the Department of Civil Engineering, Manhattan College, covers hydrology, water quality and water supply, sewage disposal and pollution, treatment of polluted waters, and rural sanitation.

With the thought that the public health engineer is becoming an increased factor in the field of public health, the authors have attempted to bring into one volume the underlying principles of environmental sanitation. Because of the large field covered, it was not practical to present too much material on any one phase. For example the broad science of heating, ventilating and air conditioning is covered in a chapter of 32 pages. However, the book is recommended for an overall picture.

Public Health Engineering, by Earle B. Phelps. Cloth bound, 5½ x 8¼ in., 655 pages. Published by John Wiley & Sons, Inc., 440 4th Ave., New York 16, N. Y. Price, $7.50.

• • •

TESTING PROPERTIES OF MINERAL WOOL—Laboratory testing methods used in evaluating the physical properties of mineral wool is described in Report of Investigations 4296, Laboratory Methods for Evaluating Materials for Mineral Wool Production. Commercial standards for industrial mineral wools, established by the Industrial Mineral Wool Institute in cooperation

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Prompt Service
Profitable Cooperation

Norman J. Learned, President
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THE Herman Nelson Corporation and carefully selected distributors like the LeValley McLeod, Inc., of Elmira, New York, do more than provide you with quality heating and ventilating products. Their friendly, close working partnership means that you get prompt delivery of quality Herman Nelson products and carefully planned merchandising cooperation which has increased profits for dealers and contractors all over America.

Effective advertising, literature and sales promotion campaigns create an acceptance for Herman Nelson products that leads to increased sales and profits. Furthermore, you are assured of immediate service from the sales and engineering departments of your nearest Herman Nelson distributor. Here's another advantage. Your Herman Nelson distributor will supply you with both equipment and installation materials promptly from stock.

Contact a Herman Nelson distributor and profit from his complete cooperation. You'll find his services increase your profits through more sales of heating and ventilating equipment.

Herman Nelson Direct Drive Propeller Fans
Herman Nelson Belt Drive Propeller Fans
Part of Herman Nelson's
QUALITY LINE
of Heating and Ventilating Equipment
Herman Nelson Model CA Fans

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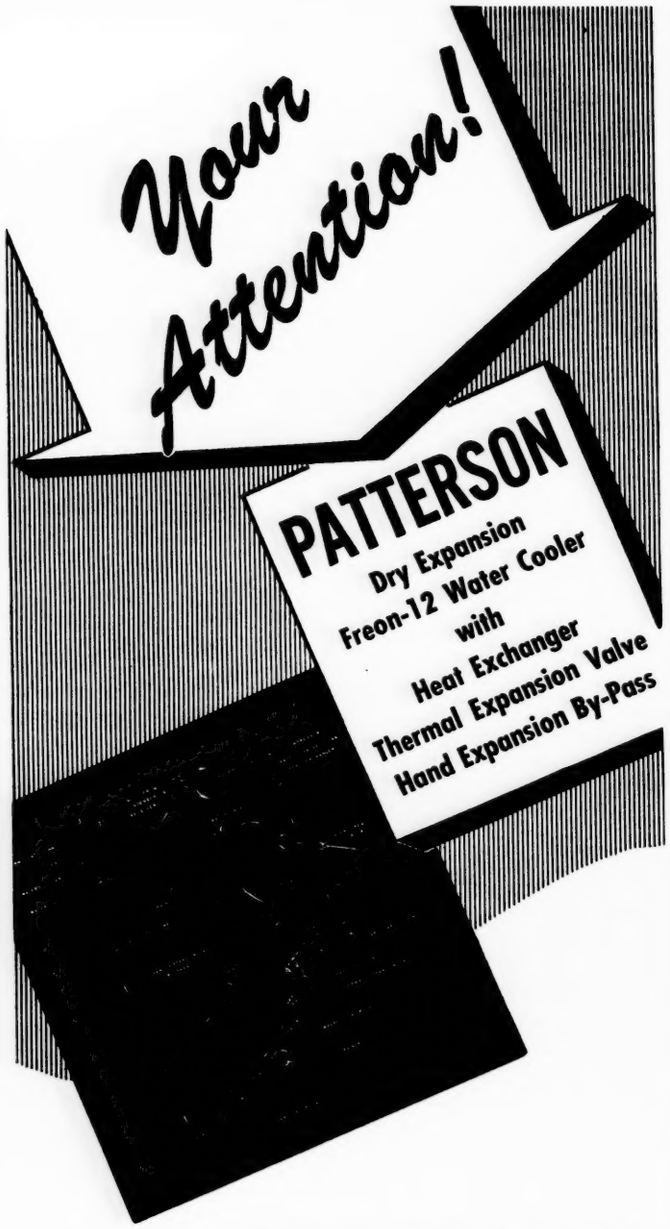

It's a compact, efficient, and effectively controlled water cooling system with a wide range of capacities. It's a carefully engineered system with each size conservatively rated. Perhaps it is just what you need for your cooling requirements. If not, we have other combinations.

Our new Freon Cooler Catalog gives details of over 100 different sizes ranging from 18.4 to 1421 square feet of cooling surface. If our standard units will not provide the unit needed, we are in position to design special coolers, special both as to type and to size. In sending for this catalog, outline your cooler requirements; keeping in mind that the design and manufacture of coolers and other "heat transfer" equipment has been our specialized business for many, many years.

EST. 1880

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with the National Bureau of Standards relate to various physical properties such as fire resistance, moisture absorption, odor emission, shot content, temperature resistance and thermal conductivity. For a copy, write to the Bureau of Mines, Publications Distribution Section, 4800 Forbes St., Pittsburgh 13, Pa.

REVISION OF FUEL OIL STANDARDS—The National Bureau of Standards has revised Commercial Standard OS 12-40 on fuel oils. This revised standard is designated as CS 12-48. The revision was developed by a technical committee of the American Society for Testing Materials to bring the standard in line with current refinery practice and burner construction. Five grades of fuel oil are covered for various types of burner equipment. Commodity Standards Division, National Bureau of Standards, Washington 25, D. C.

COAL BRIQUETTING BIBLIOGRAPHY—The Bureau of Mines has issued a bibliography on the briquetting of coal and other carbons consisting of 163 references and 161 patent listings. A copy of this work, Information Circular 7469, A Selected Bibliography on Briquetting of Coal and Other Carbons, may be obtained by writing to the Bureau of Mines, Publications Distribution Section, 4800 Forbes St., Pittsburgh 13, Pa.

SOME RECENT DEVELOPMENTS IN HEAT TRANSFER —Presented in Engineering Experiment Station Research Series No. 104 are three lectures on Some Recent Developments in Heat Transfer that were given last year at Purdue University by Dr. W. H. McAdams, Department of Mechanical Engineering, Massachusetts Institute of Technology. The object of this series of lectures was to review some of the developments in heat transfer since 1942. For a copy write to Engineering Experiment Station, Purdue University, Lafayette, Ind.

VENTILATION TESTING CALCULATOR—Developed by the Navy as a simple rapid device for testing and balancing ventilating, heating and air conditioning systems, the cardboard calculator is now available with ten pages of illustrated instructions. Included are formulas for computing air volume and velocity, instructions regarding the use of anemometers and velometers, and methods of taking observations. For PB 89769s, price $1.50, address Office of Technical Services, Department of Commerce, Washington 25, D. C.

MECHANICAL REFRIGERATION STANDARDS — The American Standards Association has just issued ASA B9, its proposed new edition of the American Standard Safety Code for Mechanical Refrigeration. In its present form, the code has not been completed and approved, and comments on the draft are still being considered by the committee. This code is sponsored by the ASRE and is approved by the ASA. The present code, now in use, has not been revised since 1939. American Standards Association, 70 E. 45th St., New York 17, N. Y.

NEW CATALOGS

Centrifugal Fans

Type "LL" Limit Load conoidal centrifugal fans are described and illustrated in Bulletin 3675, 68 pages, 2 colors. Product and installation photos, dimension and mounting diagrams, and capacity tables are supplemented by engineering and design data.—*Buffalo Forge Co., Buffalo, N. Y.* 173

L. P. Gas Water Heating

Factors affecting service, operating costs, installation and fuel consumption in L. P. gas water heaters are presented with tables of data and installation diagrams in a 16-page booklet.—*Bryant Heater Co., 17825 St. Clair Ave., Cleveland 10, Ohio.* 174

Thermometers

A 4-page bulletin describes Auto-Lite indicating and recording thermometers. Photographs illustrate models, and tables show dial ranges and other data. —*The Electric Auto-Lite Co., Instrument and Gauge Div., Toledo 1, Ohio.* 175

Foamglas Insulation

A 4-page brochure describes the use of Foamglas cellular glass insulation for low temperature work including cold storage. Tables of weights and properties are included.—*Pittsburgh Corning Corp., 632 Duquesne Way, Pittsburgh 22, Pa.* 176

Gas Unit Heaters

Pittsburgh gas unit heaters, Series C, featuring cast iron heat exchangers, are described in a 4-page bulletin. Sizes cover output range from 68,000 to 172,000 AGA Btu per hr.—*Automatic Gas Equipment Co., 301 Brushton Ave., Pittsburgh 21, Pa.* 177

Coolant Circulating Pumps

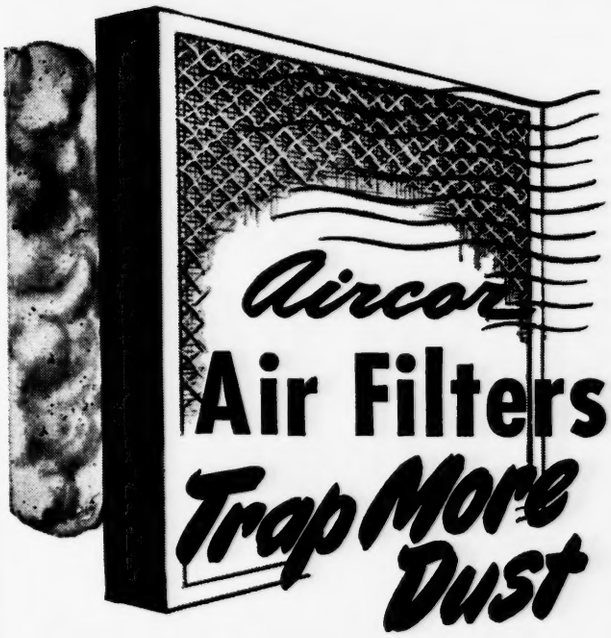
Foot mounted, submerged and side-wall mounted coolant circulating pumps are described in an 8-page bulletin. Construction details and application information is supplied.—*Allis-Chalmers Mfg. Co., 1172 S. 70th St., Milwaukee, Wis.* 178

Controls

A 40-page catalog describes L&N electric controls, position-adjusting type, applicable to processes which can be controlled by moving a valve, vane, or damper. —*Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.* 179

Condensate Return Units

Heavy duty condensate return units featuring Roth turbine type pumps are described and illustrated in an 8-page bulletin with dimensions and capacity data. —*Roy E. Roth, Rock Island, Ill.* 180



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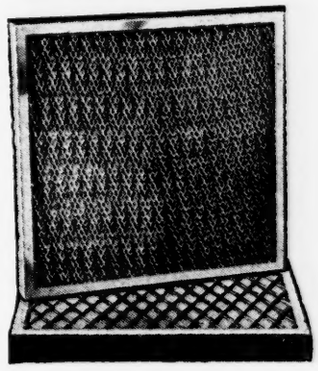

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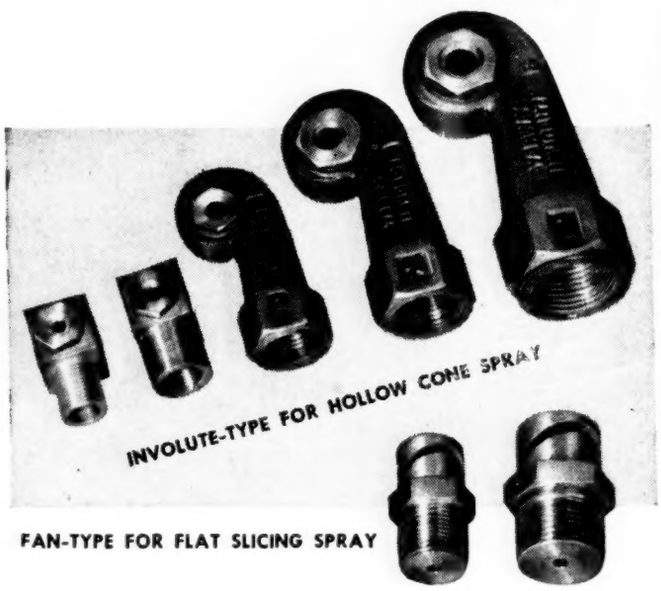

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Flexible Check Valve

A new Bulletin No. 610-B describes the operation and performance of Grove Chex-Flo check valves of the expansible tube type, which are employed on air, gas, oil or water at temperatures not exceeding 150F. —*Grove Regulator Co., 65th & Hollis Sts., Oakland 8, Calif.* 181

Synchronous Motors

Bracket- and pedestal-bearing types of synchronous motors are described and illustrated with cutaway drawings and construction details in a series of 8-page bulletins.—*Electric Machinery Mfg. Co., Minneapolis 13, Minn.* 182

Condensate Return System

A 4-page, 4-color bulletin covers the new "CBA" high differential, high pressure condensate return system. In addition to material and operating specifications, capacity ratings are given for the six different sizes available, from 3 to 25 hp based on a maximum of 200 lb per sq in. pressure differential. Drawings in color show the design construction of the new unit. —*Cochrane Corp., 17th St. and Allegheny Ave., Philadelphia 32, Pa.* 183

Pressure Reducing Valves

Catalog D-14 covers Cash-Acme pressure reducing and regulating valves for use with steam, air, gases, water, oil and other liquids. Diagrams and cutaway drawings illustrate construction of the valves. Capacity charts and installation data are included. Strainers, pressure controls, and relief valves are also shown. Piping information for wide volume range installations is presented.—*A. W. Cash Valve Manufacturing Corp., 666 East Wabash Ave., Decatur, Ill.* 184

Condensing Units

Refrigeration condensing units are described and illustrated in a 36-page bulletin which includes tables of sizes and capacities, refrigeration data and equipment characteristics. A section of general engineering data and information is included.—*Brunner Manufacturing Co., Utica, N. Y.* 185

Electric Motors

Motors for operating boiler feed, condensate pumps, coal pulverizers, pulverizer exhausters, induced- or forced-draft cooling tower fans, ash sluices and coal hoists are described and illustrated in a 26-page catalog (05B-6107A).—*Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.* 186

Spray Nozzles

Spray nozzles for air conditioning and other operations are described and illustrated in a 4-page bulletin, No. 1001. Sizing and capacity charts are included.—*Super Ice Machinery and Equipment Co., 520 W. Somerset St., Philadelphia 33, Pa.* 187

Stainless Steel Relief Valves

A 4-page bulletin describes stainless steel safety and relief valves for the chemical industry. Photographs of various valves and tables of list prices are included.—*Associated Valve Engineering Co., 1150 W. Marquette Road, Chicago 21, Ill.* 188

Variable Speed Motors

A 16-page bulletin in full color shows applications of variable speed motors. Charts and graphs illustrate uses and advantages. Cutaway drawings show operating principles and design improvements.—*U. S. Electrical Motors, Inc., 200 E. Slauson Ave., Los Angeles 54, Calif.* 189

Heating Calculator

A residence heating calculator, said to eliminate reference and conversion tables, is designed for figuring heat losses of residences, sizing ducts, sizing firing equipment, etc., and warm air heating systems. It can be used on steam and hot water applications. — *The Stokol Stoker Company, Inc., 2060 Northwestern Ave., Indianapolis 7, Ind.* 190

Remote Control Valves

A new 16-page Bulletin No. 800-B, describes the varied manual and automatic remote control applications of Grove Flexflo expansible tube valves. Included are technical data and diagrams of typical arrangements.—*Grove Regulator Co., 65th & Hollis Sts., Oakland 8, Calif.* 191

Refrigeration Accessories

Refrigeration catalog 48-25 features a line of forged flare nuts, refrigeration fittings and brass pipe fittings with other accessories for the refrigeration and air conditioning industry. — *Electrimatic, 2100 Indiana Ave., Chicago 16, Ill.* 192

OCTOBER, 1948

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188	189	190	191	192

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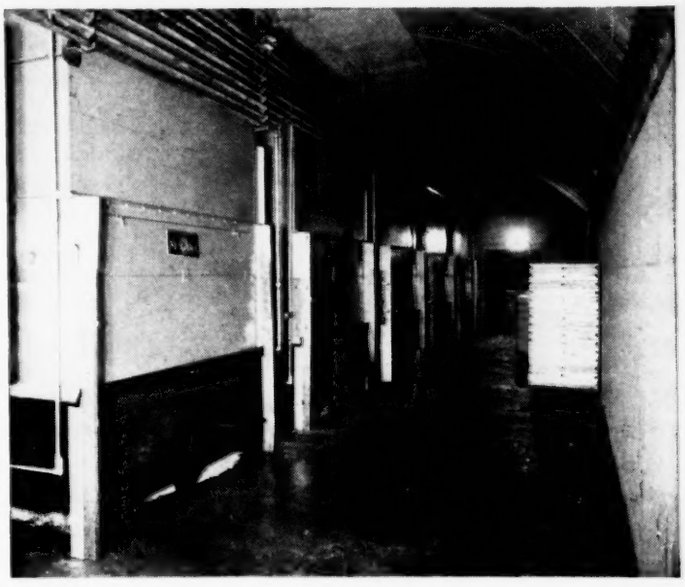

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Getting Personal

William H. Lang (*Water Treatment for Heating and Air Conditioning*, page 97) was born in Washington, Pa., and attended the public schools of that city. In 1934, he received his B.S. degree from Washington and Jefferson College. In 1938 he obtained his M.S. and in 1940 his Ph. D. at the State University of Iowa — both degrees being taken in sanitary chemistry and engineering.

W. H. Lang

Dr. Lang, in 1940, became the first Sanitary Engineer of the Bureau of Parks, Department of Forests and Waters, Commonwealth of Pennsylvania. He served as Chief Chemist and Bacteriologist for the Newport News, Va., Waterworks Commission from 1942 to 1946. During this period, the water system was expanded to include two six-mgd filtration and treatment plants which he placed in operation.

For a time he was associate editor of *Water Works Engineering*. At present he is engaged in industrial waste disposal and anti-stream pollution activity.

Dr. Lang is a member of Phi Lambda Upsilon and Phi Sigma, national honorary chemical and biological societies; American Water Works Association; and Virginia Academy of Science.

Howard M. Nichols (*Sizing Exhaust System at Branch Junctions*, Page 111) is service supervisor at the Sturtevant Division of Westinghouse Electric Corp., Hyde Park, Mass. He was born in Plainfield, Conn., and attended Rhode Island State College, receiving his Bachelor of Science degree in 1906. After three years experience in testing, drafting, and air research with General Electric Co. and one year each as erecting superintendent and salesman with other electric companies, Mr. Nichols joined B. F. Sturtevant as a designer. He became manager of the dust control and conveying department and then assistant industrial manager of the Sturtevant Division prior to his present position. He has written articles on waste removal systems, dust control, and pneumatic chip conveying. His hobbies are gardening and stamp collecting.

H. M. Nichols

Frank A. Stanton (*Sizing Exhaust System at Branch Junctions*, Page 111) is application engineer for the Sturtevant Division of Westinghouse in Hartford, Conn. He was born in Boston, Mass. and attended Northeastern University School of Industrial Engineering. He started with B. F. Sturtevant Company in 1937, part time, while attending school and staying on full time beginning 1940. He left the drafting room to go into sales in 1941 and was assigned to Springfield, Mass., and Buffalo, N. Y., until the company was purchased by Westinghouse. He still resides in Springfield where he is active in the Junior Chamber of Commerce. He has recently bought a 30 acre farm in Connecticut and one of his particular interests is trying to get back home from a call 100 miles away in time to help tuck his five children into bed.

J. E. York (*Joints for Transite Pipe*, page 91) has been requested by the National Research Council to prepare material on plumbing for a new report on the design, construction and equipment of laboratories.

CORRECTION

Graphs shown as *Fig. 10* and *Fig. 12* on pages 76 and 77, respectively, of the September issue of HEATING AND VENTILATING were inadvertently transposed. Graphs correctly labeled are shown below.

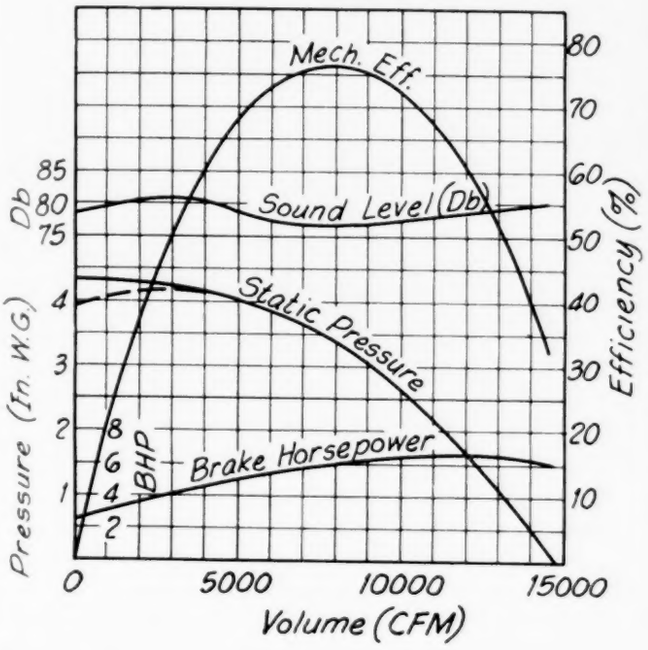

Fig. 10. Performance curves of a typical, backward-blade, centrifugal fan. Wheel diameter, 27 in.; speed, 1140 rpm.

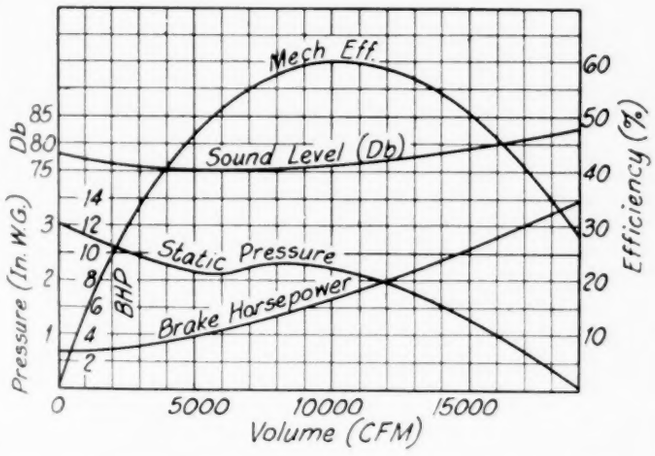

Fig. 12. Performance curves of a typical, forward-blade, centrifugal fan. Wheel diameter, 27 in.; speed, 570 rpm.

. . . Since the Last Issue

The **Henry Valve Co.**, Chicago, announces the appointment of **A. J. Nelson Co.**, of Denver, Colorado, as factory sales representative for the mountain states territory. This territory includes: Montana, Wyoming, Colorado, Utah and New Mexico.

Daniel N. Gredys has been promoted to assistant general superintendent of **Perfection Stove Co.**'s Platt Avenue plant in Cleveland, Ohio. Mr. Gredys has been with Perfection for the past 14 years.

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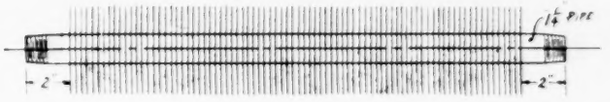

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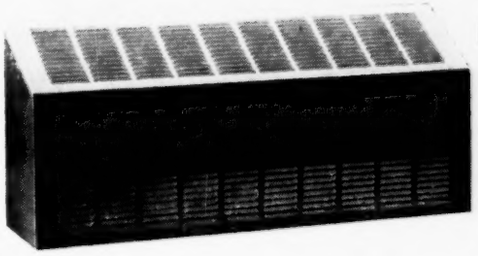

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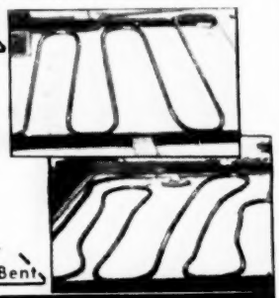

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Unit Air Conditioner Division, Fedders-Quigan Corp., announces the appointment of **Joel A. Wier** as regional manager for the southeastern territory for Fedders room air conditioners with headquarters at 25 Honour Circle N.W., Atlanta, Georgia. His territory will cover the southeastern states from Tennessee and North Carolina to Florida.

Lorin G. Miller has been appointed dean of engineering of **Michigan State College** at East Lansing. He succeeds Dean Henry B. Dirks, retired. Dean Miller received his bachelor of science degree in electrical engineering from Des Moines University, and conducted advanced study at the Massachusetts Institute of Technology. He was employed three years by Western Electric Company, and taught on the engineering faculties of the University of Wisconsin and Des Moines University. He came to Michigan State College as professor of mechanical engineering in 1929, and has served as head of that department from 1935 until his recent appointment as dean.

L. G. Miller

J. R. Lavelle has been made manager of the New York City direct-factory branch of the **Ruud Manufacturing Co.,** Pittsburgh, Pa., makers of automatic gas water heaters.

American District Steam Co., manufacturers of steam distribution equipment, North Tonawanda, N. Y., announce the opening of a branch office at 1922 Oliver Bldg., Pittsburgh 22, Pa., under the supervision of **J. A. Gustafson,** branch manager.

Hoffman Specialty Co., Indianapolis, Ind., announces acquisition by this company of the well known Blake Manufacturing Co., Rock Island, Illinois, formerly known as Blake Specialty Company. Effective October 1, 1948, business matters pertaining to Blake products will be handled at Indianapolis. Blake manufacturing facilities and inventory will be moved to Indianapolis in such a manner as to avoid interference with production and shipping schedules.

The appointment of **The R. G. Dinham Co.,** Wesley Temple Building, Minneapolis, Minn., as distributor is announced by **Economy Pumps, Inc.,** Hamilton, Ohio.

Worthington Pump and Machinery Corp., announces that the Air Conditioning and Refrigeration Distributor Service Department has been combined with the Air Conditioning and Refrigeration Sales Division. The New department will be under the direction of **E. C. Hamilton** as manager, with headquarters at Holyoke, Mass. Mr. Hamilton has been associated with the Holyoke works since 1938, and in 1943 was made manager of the Air Conditioning and Refrigeration Service Dept. He is a member of the Refrigeration Service Engineers Society, and the American Society of Refrigeration Engineers. Formerly of Glenwood, Iowa, Mr. Hamilton attended Des Moines University and Coyne Electrical College.

E. C. Hamilton

The Coleman Company, Inc., has purchased the La Porte, Indiana factory of Hoosier Industries, Inc. A complete line of automatic water heaters in both oil and gas-burning models will be produced there. **Lee P. Corsbie,** president of Hoosier Industries, has been retained as general manager of the Indiana plant.

Jas. P. Marsh Corp., Skokie, Ill., has announced the acquisition of the Witt Gauge Division of National Pressure Cooker Co., Eau Claire, Wisconsin, effective September 30. The identity of the Witt line will be preserved, but Witt gauges including the oxygen and welding gauges, will be produced in the Marsh plant of the Witt Gauge Division of Jas. P. Marsh Corporation.

Appointment of **Charles A. Miller** as personnel manager of the **Pyle-National Co.** of Chicago, is announced. Mr. Miller has been associated with the company for eight years. He began as an assembler in the railroad headlight manufacturing division.

Duo-Therm Division, Motor Wheel Corp., Lansing, Michigan, has announced the appointments of **T. R. Merrill** and **Arthur Kretschman** as field engineers.

R. L. Persons has been named district manager of the St. Louis territory for **Penn Electric Switch Co.** He replaces O. G. Tinkey, former manager.

William J. Marshall, international president of the **Refrigeration Service Engineers Society,** has announced the appointment of **Paul B. Reed** as full-time educational director of the society. Mr. Reed has been active for a number of years in the educational works of the society, first as chairman of the Wartime Educational Committee, and for the last two years as chairman of the International Educational and Examining Board. Starting in 1919 as a service man for a Kelvinator dealer in Louisville, Kentucky, Mr. Reed worked on some of the earliest electric refrigeration equipment. Joining Servel in 1926 he was with that company in shop, engineering, and service work for 18 years, the last nine of which he served as service manager of the Electric Refrigeration and Air Conditioning Division. In 1943 he joined the Perfex Corp., as manager of the Refrigeration Controls Division. In addition to his R.S.E.S. activity, he is a past chairman of the Milwaukee section of the American Society of Refrigerating Engineers, and has served on several ASRE national committees and has spoken before a number of ASRE sections.

P. B. Reed

Appointment of **Henry F. Goetz** as sales engineer and **William W. Reeves** as applications engineer is announced by **Fedders-Quigan Corp.,** Buffalo, N. Y.

Jet-Heet, Inc., announces removal of their offices and laboratories to their new and larger quarters at 152 S. Van Brunt Street, Englewood, N. J.

Charles J. Wurmfeld and **Eric Singleton** have resigned from the engineering firm of Gibbs & Cox to open their own consulting engineering offices at 150 Nassau St., New York City.

DeBothezat Fans Division of American Machine and Metals, Inc., has announced the appointment of **Harold L. Mooney** as director of market research. Mr. Mooney has had more than twenty years' experience in market research. He is a member of the Market Research Council and the American Marketing Association.

Bastian-Morley Co., Inc., La Porte, Ind., manufacturers of Crane-Line water heaters and Basmor gas fired boilers, announces the appointment of **F. M. Pain** as sales manager. For the past three years, Mr. Pain has been district manager for Rheem Manufacturing Co. Prior to that, he was with General Water Heater Corp. as district manager.

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THE AUER REGISTER COMPANY 3608 Payne Ave., Cleveland 14, Ohio

The appointment of **Haggerty, Inc.,** Tampa 1, as exclusive Florida distributors for Harry cooling towers and evaporative condensers has been announced by **Harry Cooling Towers, Inc.,** Doylestown, Pa.

Bryant Heater Co. of Cleveland, Ohio, has named **Howard A. Kennedy** as advertising manager for consumer products. He succeeds Mr. Fred O. Habegger who recently became sales manager of Bryant-Williams Co., Pittsburgh, Pa. Mr. Kennedy was formerly an associate account executive with Fuller & Smith & Ross. He is a graduate of Ohio Northern University and is a member of Sigma Phi Epsilon Fraternity. In his new capacity as advertising manager, he will coordinate the various advertising efforts of Bryant Heater Company.

H. A. Kennedy

Modine Manufacturing Co., announces the appointment of new representatives for the Phoenix, Arizona, San Francisco, California and Knoxville, Tennessee territories. In the Phoenix territory, **Alfred C. Baechlin,** P.O. Box 912, will handle the complete line of Modine unit heaters, convectors and coils. Norman Brown will represent Modine in the San Francisco, California territory. Mr. Brown's address is 765 Minna Street, San Francisco 3, Calif. The Knoxville territory will be covered by E. Lloyd Widner, 220 Mercantile Bldg., Knoxville, Tenn.

M. P. L. Love, director of research at **Shell Oil's** Wood River, Ill., refinery, has been named research department manager in the company's New York head office. In his new capacity, Mr. Love will coordinate and direct all manufacturing-research programs in the company's East-of-Rockies territory. **R. J. Greenshields,** chief engineer at the Wood River laboratories, will succeed Mr. Love as research director there.

Lester R. Varney, 53, of the advertising and sales promotion department of **Crane Co.,** Chicago, died August 21, of coronary thrombosis. Death came suddenly as he was about to leave for a vacation. Mr. Varney had been a member of the Crane organization for 35 years, spending the greater part of this time with the advertising and sales promotion department. He was well-known in the publishing field as manager of Crane's extensive plumbing and heating advertising program and editor of the consumer magazine "Home Desirable." **Hugh M. Kanagy** has been appointed assistant manager of the advertising and sales promotion department for Crane Co. Mr. Kanagy has been a member of the sales training department for the past few years.

Walter C. Winkel, president of the **Modine Manufacturing Co.,** Racine, Wis., died on August 22 at the age of 59. Mr. Winkel had been a director of the firm for 25 years. Born in Cleveland, he came to Racine with the Wallis Tractor Co., later the J. I. Case Plow Works. At the request of Arthur B. Modine, he joined the Modine Manufacturing Co. as purchasing agent in 1920. He served successively as secretary, vice-president and treasurer, executive vice-president, and was elected president in 1946.

W. C. Winkel

Directors of the **Pyle-National Co.,** have elected **Durward I. Packard,** for nearly five years district manager of the Baldwin Locomotive Works, vice-president in

charge of sales. Mr. Packard during World War II was a dollar-a-year man with the War Production Board. Before that he was associated with the New York Central Railroad in the motive power department in various capacities for nearly 12 years. Mr. Packard was also supervisor of manufacturing operations of the Franklin Railway Supply Co.

Appointment of **Frank J. Smith** as advertising and sales promotion manager of the **Philip Carey Mfg. Co.**, Cincinnati, Ohio, has been announced. Mr. Smith succeeds Harold D. Bates, who was recently promoted to general merchandise manager. Mr. Smith joined the Carey Company in January, 1948 after several years in the sales and advertising departments of Owens-Corning Fiberglas Corp. He is a graduate of Ohio State University and a veteran of World War II.

COMING EVENTS

OCTOBER 12-16, 1948—Fifth National Chemical Exposition and National Industrial Chemical Conference, Coliseum, Chicago. Marcus W. Hinson, Manager of Exposition, 1505 S. Wabash Ave., Chicago 5, Ill.

NOVEMBER 3-4, 1948—Meeting of the Fuels Division, American Society of Mechanical Engineers, White Sulphur Springs, W. Va. Secretary, C. E. Davies, 29 W. 39th St., New York, N. Y.

NOVEMBER 19-22, 1948—11th annual convention, Refrigeration Service Engineers Society, Hotel Sherman, Chicago, Ill. Willis Stafford, Chairman, Publicity Committee, 433 N. Waller Ave., Chicago 44, Ill.

NOVEMBER 28-DECEMBER 3, 1948 — Annual meeting, American Society of Mechanical Engineers. Hotels Pennsylvania and New Yorker, New York City. Secretary, C. E. Davies, 29 W. 39th Street, New York, N. Y.

DECEMBER 5-8, 1948 — Annual convention, American Society of Refrigerating Engineers, Hotel Statler, Washington, D. C. Secretary, M. C. Turpin, 40 West 40th St., New York 18, N. Y.

DECEMBER 9-10, 1948—35th annual convention, National Warm Air Heating and Air Conditioning Association, Hotel Cleveland, Cleveland, Ohio. Secretary, George Boeddener, 145 Public Square, Cleveland 14, Ohio.

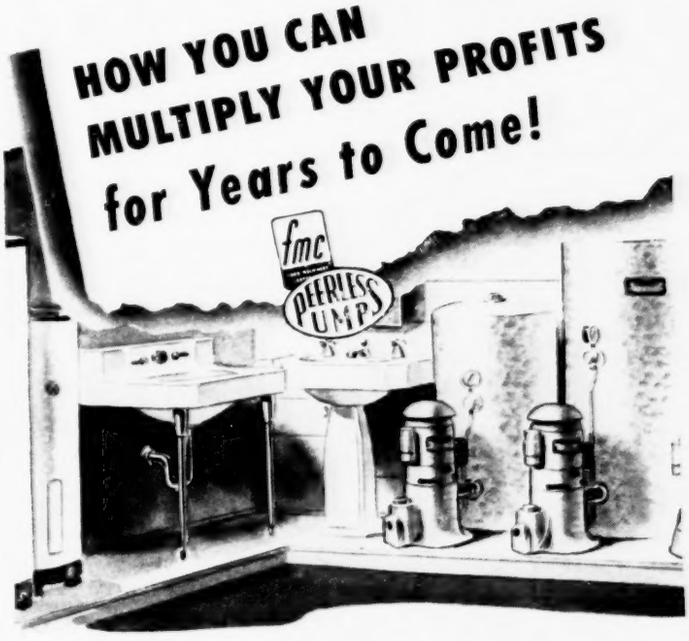
JANUARY 24-28, 1949—Heating, Ventilating and Air Conditioning Exposition, American Society of Heating and Ventilating Engineers, International Amphitheatre, Chicago, Ill. A. V. Hutchinson, secretary, 51 Madison Ave., New York, N. Y.

JANUARY 25, 1949—Annual convention and membership meeting, National Heating Wholesalers' Association, Blackstone Hotel, Chicago. National Heating Wholesalers Association, 239 Water St., Pittsburgh, Pa.

APRIL 18-20, 1949—1949 Midwest Power Conference, sponsored by Illinois Institute of Technology, at Hotel Sherman, Chicago. Conference director, Roland A. Budenholzer, at Illinois Tech, 3300 So. Federal St., Chicago 16, Ill.

MAY 24-27, 1949 Annual meeting, National District Heating Association, The New Ocean House, Swampscott, Mass. Secretary, John F. Collins, Jr., 827 N. Euclid Ave., Pittsburgh 6, Pa.

NOVEMBER 14-19, 1949—All-Industry Refrigeration and Air Conditioning Exposition, Atlantic City, N. J. Refrigeration Equipment Manufacturers Association, 1107 Clark Bldg., Pittsburgh 22, Pa.



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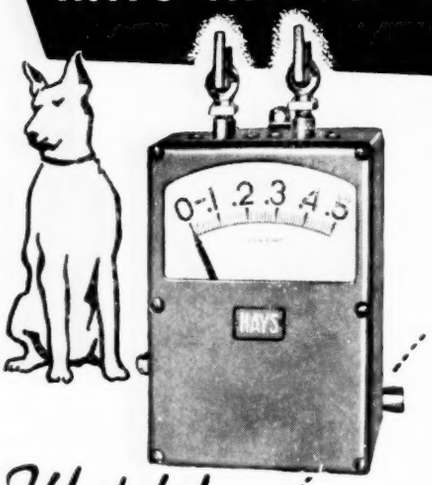

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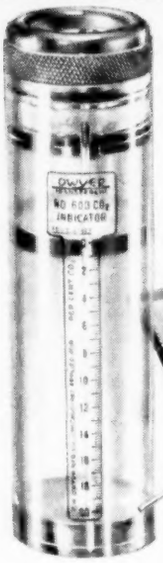

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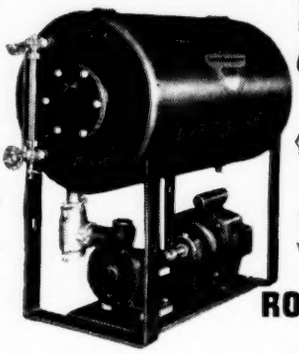

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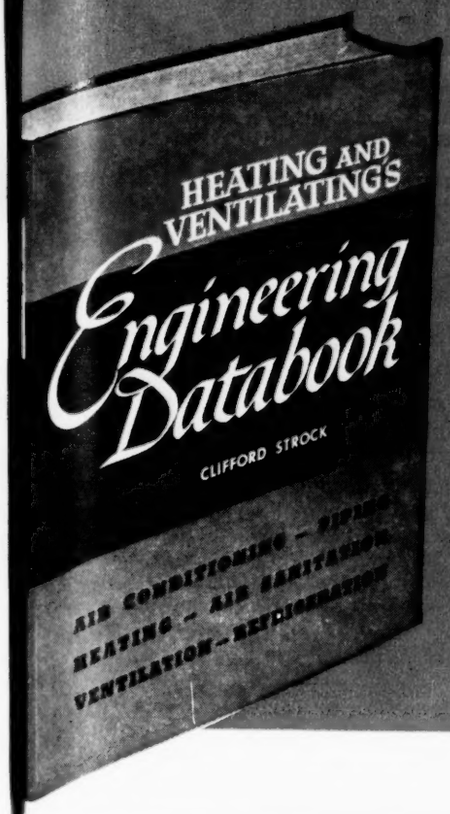

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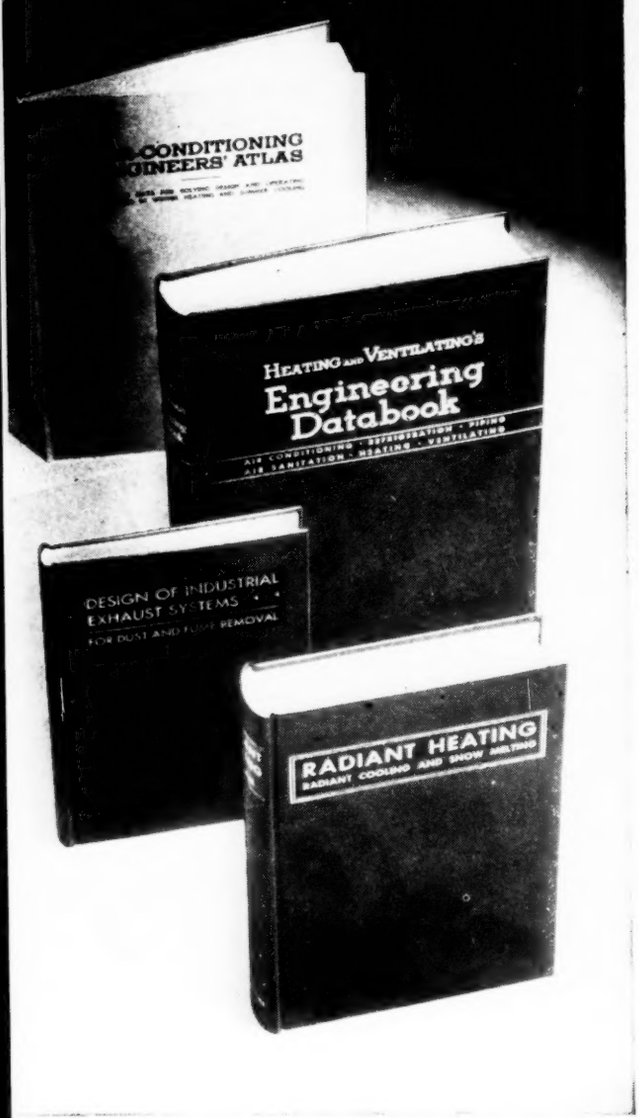

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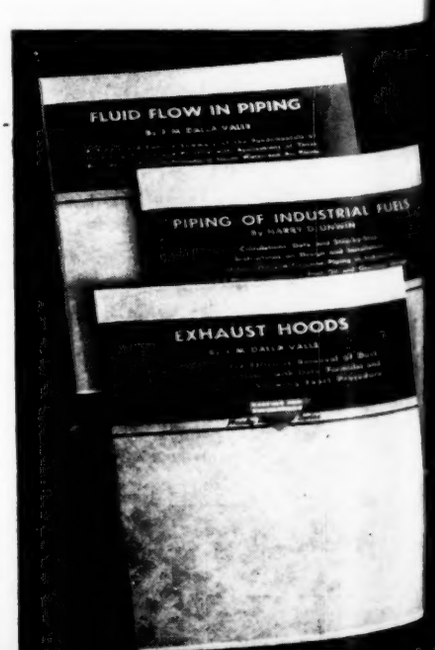

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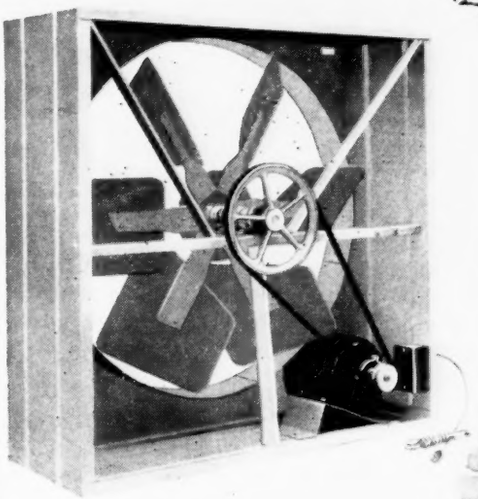

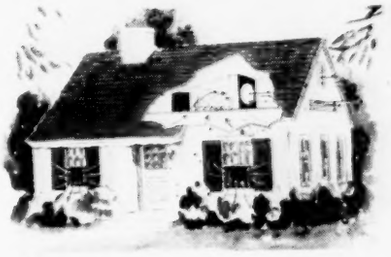

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